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GEOLOGIC SECTION OF THE CHILLICOTHE TEST-CORE

J. ERNEST CARMAN,
Department of Geology,
The Ohio State University

In the autumn of 1944 the Engineering Experiment Station of The Ohio State University put down a test boring southwest of Chillicothe, Ohio, for the purpose of obtaining a drill core for the determination of the petroleum content of the Ohio shale, foot by foot. Mr. L. C. Karrick, formerly of the U. S. Bureau of Mines, where he had had much experience in analyzing oil shale and coal, supervised the taking of the core and made the analyses for petroleum. A report on this study will be published by the Engineering Experiment Station at an early date.

The Experiment Station officials[1] allowed the writer to study the core and after the analyses were made, the unused parts were turned over to the Department of Geology. These include alternate ½-inch sections of the core through the Ohio shale and the complete core through the other formations.

The location of the test well is about three miles southwest of Chillicothe, on the south slope of Paint Creek Valley on the Hirsh Orchard Farm.[2] This is in the edge of the Appalachian Plateau where the surface is rugged and the local relief is 400 to 600 feet. A north-south cross section sketch of Paint Creek Valley is shown in Figure 1. The elevation of Paint Creek is here about 610 feet. The valley is broad with steep slopes which rise to a bench at 880 to 900 feet. Just below the edge of the bench the Berea sandstone commonly crops out in a cliff at the top of the steep valley side where it is undermined by the more rapid weathering and slumping away of the softer Bedford shale below. The lower slopes are at the level of the Ohio shale which is rarely exposed. The bench is at the horizon of the Sunbury shale and the overlying Cuyahoga shale which have been worn away more rapidly than the more resistant Berea sandstone below. The bench on the south is about one-fourth of a mile wide and beyond this the surface rises to a hill capped with a sandstone unit of the Logan formation at an elevation of 1260 feet.

The test boring is located near the edge of the bench at an elevation of about 880 feet. The total depth is 577 feet and the bottom of the well should have an

[1]C. E. MacQuigg, Director; J. R. Shank, Assistant Director; T. H. Kerr, Supervisor of Fuels Research.

[2]From the Hirsch farm house on the south side of Paint Creek Road, a private farm road extends southwest for about one-fourth of a mile, up the slope along the course of a small run to the orchard located on a bench. The test boring is located about 50 yards northeast of where the farm road comes out of the head of the ravine onto the bench. The location of the test boring is in the southeast part of the Roxabell quadrangle, approximately 3300 feet S. 78° W. from the road fork which is just south of Paint Creek and one-eighth of a mile west of the east line of Huntington Township.

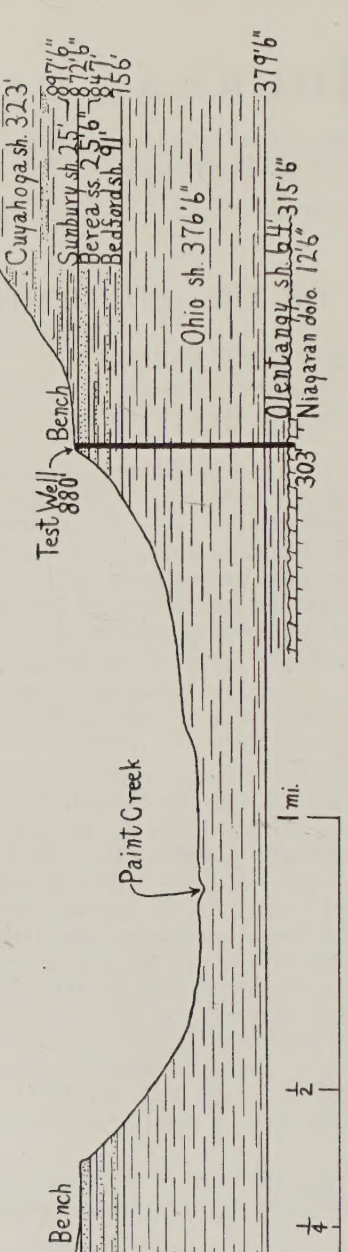

FIG. 1. North-south cross section of Paint Creek Valley about 3 miles southwest of Chillicothe, passing through the Chillicothe test well.

elevation of about 303 feet, at about 300 feet below the level of Paint Creek. The section of rock units penetrated is as follows:

Rock Unit	Thickness Ft.	Thickness In.	Depth to Base Ft.	Depth to Base In.
Mantle rock	6	6	6	6
Sunbury shale	1	0	7	6
Berea sandstone	25	6	33	0
Bedford shale	91	0	124	0
Ohio shale	376	6	500	6
Olentangy shale	64	0	564	6
Niagaran dolomite	12	6	577	0

The first study of the core was very detailed in an attempt to separate every recognizable zone or unit. In this study 114 zones were separated and described. In a later study this was reduced to 35 zones and again to a general section of 16 zones which is given below.

GEOLOGIC SECTION OF THE CHILLICOTHE TEST CORE

	Ft.	In.
Mantle rock. 6 feet, 6 inches.		
1. Clay and fragments of yellow sandstone	6	6
Sunbury shale. 1 foot.		
2. Black, fissile shale with *Lingula melia* and *Orbiculoidea herzeri*	1	0
Berea sandstone. 25 feet, 6 inches.		
3. Medium-grained, blue-gray sandstone with thin shaly partings	25	6
Bedford shale. 91 feet.		
4. Interbedded thin laminae and lenses of blue-gray sandstone and shale, with a few layers of sandstone 2 to 12 inches thick in the upper half and a 3-inch layer of sandstone at the base	22	6
5. Interbedded thin laminae and lenses of blue-gray sandstone and dark-blue shale in about equal amounts	20	0
6. Interbedded thin laminae and lenses of dark-blue shale and blue-gray sandstone with a few layers of sandstone 1 to 4 inches thick	26	6
7. Interbedded dark-blue and blue-gray shale with a few laminae and thin layer of sandstone in the upper half	22	0
Ohio shale. 376 feet, 6 inches.		
8. Black shale with *Lingula*, fishplates, conodonts and macrospores	25	6
9. Black to brownish-black shale with *Lingula*, fishplates and macrospores	44	0
10. Black shale with a few layers of blue shale 2 to 6 inches thick	5	6
11. Brownish-black and blue-gray shale in interbedded thin layers and laminae	21	0
12. Brownish-black shale with a few layers of blue-black and blue-gray shale and with a few gray, calcareous partings in the lower half	48	9
13. Brownish-black shale with thin layers and lenses of blue-black shale	168	6
14. Brownish-black shale with a few 2- to 6-inch layers of blue-gray shale	63	3
Olentangy shale. 64 feet.		
15. Blue-gray shale with layers of brownish-black, especially in basal 5 feet. *Lingula*, conodonts and macrospores in basal 2 feet	64	0
Niagaran dolomite. 12 feet, 6 inches.		
16. Bluish-gray to brownish-gray dolomite with quite variable texture	12	6

The highest bedrock present at the site of the test boring is the basal one foot of the Sunbury shale. Lying just below the mantle rock, this shale was greatly weathered and was not saved in the drill core. It was penetrated also in an excavation for a water-basin just beside the test boring and small fragments from this excavation showed the typical, black, fissile Sunbury shale, as well as the two characteristic fossils *Lingula melia* and *Orbiculoidea herzeri* which are so persistently present in central Ohio in the basal six inches of the Sunbury shale.

The upper five feet of the Berea sandstone of this core is much broken by weathering, yellow to buff in color, and contains thin partings and veins of ferruginous material. The lower half is argillaceous to shaly sandstone with an increasing number of partings and thin layers of shale downward. In fact the contact between the Berea and the Bedford must be somewhat arbitrarily chosen. There is no suggestion of a break between them.

The distinctive feature of the Bedford is the prominent and persistent alternation of thin layers and lenses of sandstone and shale within which are also a few definite layers of sandstone, increasing in thickness and number upward through the formation. In Franklin and Delaware counties most of the Bedford is soft clay shale with sandy laminae and thin layers in the upper 20 to 30 feet in some exposures. In the test-core section only the basal 10 to 15 feet is clay shale and all the rest contains abundant lenses and thin layers of sandstone The first appearance of arenaceous sediments came earlier in Ross County than in Franklin County. Further, the soft chocolate-brown clay shale that forms the middle part of the Bedford in Franklin and Delaware counties is not present in the test-core section. In the basal few feet of the Bedford of the test-core the fossils *Lingula* and *Orbiculoidea* were seen. They were very poorly preserved impressions, unidentifiable as to species. They were probably *Lingula meeki* and *Orbiculoidea newberryi* which are part of the larger fauna found in the basal two feet of the Bedford shale in Franklin County.[3] The contact of the Bedford with the Ohio shale below is definitely conformable.

The Ohio shale is black to brownish black with thin layers of blue-black to blue-gray shale. It is very uniform in color and texture and the slight differences upon which zones may be based in this test-core section could not be expected to hold laterally over large areas. In general the highest 75 feet is the blackest part and has the fewest bluish layers while the lowest 75 feet has the most bluish shale. That part between 75 and 150 feet below the top of the Ohio shale has a few thin, gray, calcareous partings.

Fossils found in the Ohio shale of this core include conodonts, minute fishplates, macrospores, and the brachiopod, *Lingula*. These fossils have not yet received the detailed microscopic study which most of this material requires and only general statements will be made concerning them.

The only invertebrate found is the brachiopod *Lingula*, of which there are two species: a smaller, elongate, subrectangular form about one-fourth of an inch long, apparently *Lingula spatulata*, and a larger, broader, more oval form about half an inch long. The smaller form was seen in the black shale at a number of levels in the upper 70 feet of the Ohio, at 91 feet below the top in blue shale, and at several levels at 4 to 12 feet above the base in mixed black and blue shale. The larger form was found at 83 and 91 feet below the top and at 18 feet above the base, all in blue-gray shale.

A number of conodonts were found in the upper 12 feet of the Ohio shale where the study was made with the binocular microscope. Below this level the microscope was not used and only a few conodonts were seen but it is probable that an examination with the microscope would reveal them throughout most of the formation. Several types of conodonts were recognized.

Small, black, glossy plates about one-eighth of an inch across, of several shapes and markings, were found at various levels in the Ohio shale. They resemble ganoid fish scales and apparently belong to the Rhadnichthids as figured by Branson from the Ohio shale of northern Ohio.[4]

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[3]Stauffer, C. R., Columbus Folio: U. S. Geol. Survey Folio 197, 1915, p. 7.

[4]Branson, E. B., Notes on the Ohio Shales and their Faunas: The University of Missouri Bulletin, Science Series, Vol. 2, No. 2, 1911, pp. 23–32.

The most abundant fossil of the Ohio shale is the minute, round, amber-colored macrospore, .25 to .5 millimeter in diameter known as *Protosalvinia huronensis.* They are common in the upper 25 feet of the formation and below this to about 200 feet they are present but uncommon. From 200 feet to the base at 376½ feet they are common and at some partings so abundant as to almost cover a bedding surface and give to it a brown color.

A very definite contact can be drawn between the Ohio and the Olentangy shales, but also it is a very definitely conformable contact. The lithologic difference between the two formations is only a matter of percentage of the kind of material making up both formations. The Ohio is dominantly black or brownish-black shale with layers of blue-black or blue-gray shale while the Olentangy is dominantly blue-gray shale with layers of brownish-black shale, which in this test-core section continue to the base of the Olentangy, for here the basal 3 feet is the blackest part of the formation. This section shows a close relation for the two formations, which should mean a close age relation. It supports the conclusions of Lamborn that the Olentangy shale of southern Ohio "is a basal phase of the Ohio shale and therefore Upper Devonian in age."[5]

Parts of the blue shale of the lower two-thirds of the Olentangy are slightly calcareous and the lower one-third contains small nodules or thin layers of calcareous material. Pyrite nodules were found at several horizons and also lenses and layers with much disseminated pyrite. Plant impressions or carbon films were seen at three horizons and a thin layer of grainy, fragmental material at two feet about the base yielded several types of conodonts, macrospores, and a few distorted specimens of a small Lingula.

The base of the Olentangy is firmly joined through a ½-inch, transition unit of grainy or fragmental material, to a crystalline dolomite below. The contact is uneven and it is definitely a disconformable contact. This dolomite was penetrated to a depth of 12 feet 6 inches, the bottom of the test boring. The dolomite is bluish-gray to brownish-gray and quite variable in texture. In part it is firmly crystalline and compact; in part of very rough texture with open spaces containing petroliferous staining; at places apparently brecciated as if crushed reef-material; the basal 4 feet is largely oolitic dolomite. No identifiable fossils were found in the dolomite but in the porous, crushed reef-rock material there are structures that suggest the compound coral *Favosites* and concentrically laminated masses suggesting stromatoporoids, all greatly altered. Although not absolutely conclusive, the evidence indicates that this dolomite is upper Niagaran, probably about the equivalent of the Peebles dolomite of Highland and Adams counties. That is, the Upper Devonian shale rests disconformably on Middle Silurian dolomite.

Passing southward from central Ohio the Olentangy-Ohio unit overlaps the outcrops of the Delaware and Columbus limestones in Pickaway County and thence southward to the Ohio River rests upon either the Greenfield or Niagaran dolomites. Further, in many of the sections of eastern Highland and Adams counties the Olentangy blue shale unit is missing and the Ohio black shale rests upon the Greenfield or Niagaran. This is readily explained by the interpretation that the Olentangy is merely a non-carbonaceous phase of the greater Ohio shale, a phase which was formed generally, but not everywhere, during the early part of the Ohio shale stage, being contemporaneous with black shale which was forming elsewhere.

The test-core section shows 64 feet of Olentangy shale between the Ohio shale and the dolomite. However, on the outcrop, 20 miles to the west near Greenfield, or 16 miles to the west-southwest near Bainbridge, the Ohio shale rests directly on the dolomites. This may mean that the deposition of the black sediments

[5]Lamborn, Raymond E., The Olentangy Shale in Southern Ohio: Jour. Geol., Vol. 35, 1937, p. 722.

was at a later time and extended farther westward on the old erosion surface than did the blue sediments, or more probably it means that the sediments laid down farther west at Greenfield and Bainbridge contained enough carbonaceous material to make black shale while farther east at the test-core site, contemporaneous deposits without carbonaceous material resulted in blue shale. This accords with the usual interpretation of an eastward source for the Upper Devonian sediments, which were carried westward into a shallow, possibly stagnant, sea area where plant growth furnished the carbonaceous material for making black shale.

The test-core section shows that the west edge of the Columbus-Delaware limestone unit which is overlapped in west central Pickaway County, must run southeast or southeast-by-east in order to pass east of the test-core site which is 16 miles east and about 20 miles south of where the limestones are overlapped. It also shows that the Silurian-Devonian disconformity, which along the outcrop in eastern Highland County is at approximately the contact of the Greenfield dolomite on the Niagaran dolomite does not rise eastward across the dip of the strata, but descends eastward with a somewhat greater dip than the strata in order that the Devonian shales rest on the Niagaran at the test-core site. The base of the Devonian shales, which on the outcrop south of Greenfield has an elevation of about 970 feet, drops to about 315 feet at the test-core site; a drop of about 655 feet in 20 miles to the east, or about 33 feet per mile, which is approximately the regional dip of this part of the state. Assuming that the old erosion surface which truncates the Silurian dolomites was approximately horizontal and that the Upper Devonian shales were laid essentially horizontal, it appears that all the regional dip was produced in post Devonian time.

WAYNESBURG COAL IN HARRISON AND NORTHERN BELMONT COUNTIES, OHIO, AND REVISION OF DUNKARD (PERMIAN) BOUNDARY

GEORGE W. WHITE,
Geological Survey of Ohio

INTRODUCTION

In a study of the Monongahela formation in Harrison County and northern Belmont County it was discovered that the Waynesburg coal is more extensive than formerly known. As the Waynesburg coal is of minable thickness at many places, a map and brief description of the coal may be of value. In addition, as the top of the Waynesburg coal is the dividing plane between the Pennsylvanian and Permian systems of strata, this study provides a modification of the geologic map of the base of the Dunkard (Permian) rocks,[1] especially in Harrison County where no Permian was shown. The map, Plate I, includes parts of the Flushing and St. Clairsville quadrangles of the U. S. Geological Survey, which have been used as a base. The outcrop of the Waynesburg coal is shown by a black line, the measured elevations being indicated. The area shown in green is the area underlain by the coal and that where the surface rocks are Dunkard (Permian) in age. The location of this area in Ohio is shown on an index map, Fig. 1.

The writer's field study in Harrison County and in Belmont County north of the National Road, is a northward extension of the work of Dr. Wilber Stout on the Monongahela formation in the "main field" to the south. Dr. Stout's monographic report in the files of the Geological Survey is being prepared for publication and a discussion of the Monongahela stratigraphy of the area north of the National Road will be added to his report. On Plate I the outcrop line and sections shown south of the National Road and in southeast Colerain Township are from Stout's data. The report and maps of Lamborn[2] have been used for that part of Jefferson County shown on Plate I. The areal reports of Mitchell[3] on Richland Township and of Eberle[4] on Flushing and Wheeling townships were useful and E27 and E21 of Plate I, shown as 161 and 173, respectively, on Plate II are after Eberle.

STRATIGRAPHIC POSITION

The top of the Waynesburg coal is the boundary between the Monongahela formation, of Pennsylvanian age, and the overlying Washington formation of the Dunkard Series of Permian age.[5] The base of the Monongahela formation is the base of the Pittsburgh coal. Sections of the Monongahela formation have been given by Stout[6] and the section at Blaine Hill on the National Highway in N.E.

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[1]Stauffer, C. R., and Schroyer, C. R., "The Dunkard Series of Ohio," *Geol. Survey Ohio Bull. 22*, map, p. 12, 1920.

[2]Lamborn, R. E., "Geology of Jefferson County," *Geol. Survey Ohio Bull. 35*, 1930.

[3]Mitchell, R. H., "The Geology of Richland Township, Belmont County, Ohio," unpublished thesis, Ohio State Univ., 1929.

[4]Eberle, R. F., "The Geology of Wheeling and Flushing Townships, Belmont County, Ohio," unpublished thesis, Ohio State Univ., 1936.

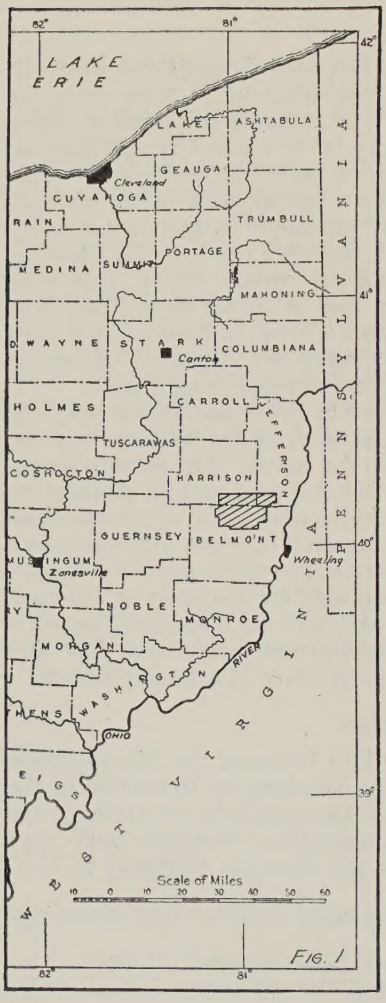
[5]White, I. C., "Stratigraphy of the Bituminous Coal Field of Pennsylvania, Ohio, and West Virginia," *U. S. Geol. Survey Bull. 65*, p. 41, 1891.

Stauffer and Schroyer, *op. cit.*, pp. 9–11.

[6]Stout, W., "The Monongahela Series in Eastern Ohio," *Proc. W. Va. Acad. Sci.*, Vol. 3, pp. 118–133, 1930.

Idem, "Generalized Section of the Coal-Bearing Rocks of Ohio," *Geol. Survey Ohio Inf. Circ. No. 2*, 1939.

Sect. 21, Richland Township, Belmont County, has been described by the writer[7] and is shown (in part) graphically in 187, Fig. 2. According to Stout[8] the top of the Waynesburg coal in Belmont County (not including measurements from the central northern and northwestern parts) lies on the average 253 feet above the base of the Pittsburgh coal, 162 feet above the Meigs Creek coal, 103 feet above the Fulton green shale, and 50 feet above the Uniontown coal. At the Blaine Hill section (Fig. 2), these intervals are smaller but not significantly so, being 240½,



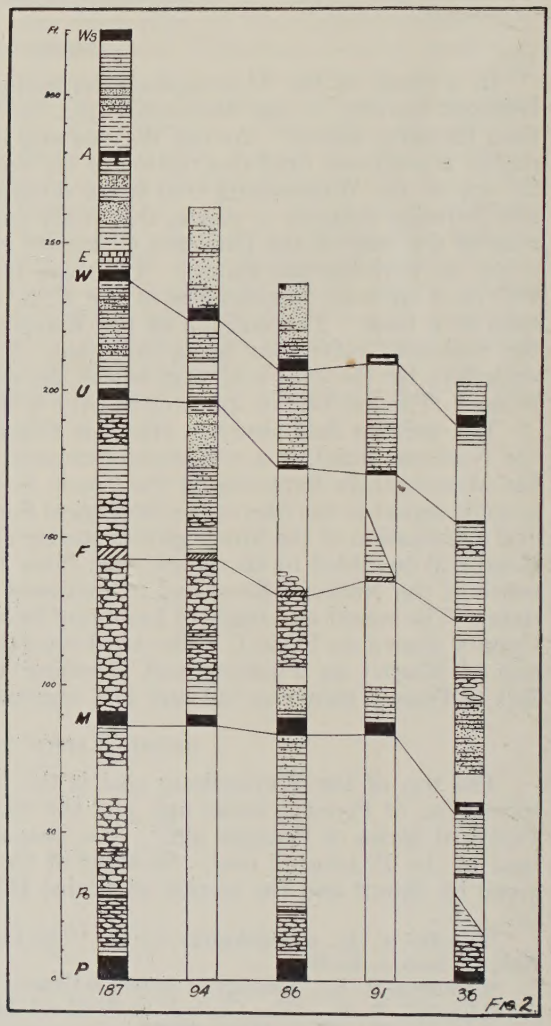


FIG. 1. Map of eastern Ohio showing location of area.

FIG. 2. Columnar sections of strata. Locations of sections shown on Plate II and given in text. Key: P, Pittsburgh coal; Po, Pomeroy coal; M, Meigs Creek coal; F, Fulton green shale; U, Uniontown coal; W, Waynesburg coal; E, Elm Grove limestone; A, Waynesburg "A" coal; Ws, Washington coal.

[7]White, G. W., "Upper Pennsylvanian and Lower Permian Rock Section at Blaine Hill, Belmont County, Ohio," *Ohio Jour. Sci.*, Vol. 45, pp. 173–179, 1945.

[8]Stout, "Monongahela Series. . . . ," *op. cit.*, p. 121.

81°5′
81°0′
40°10′
40°5′
HARRISON CO.
BELMONT CO.
Scale
4 Miles
5 Kilometers
Contour interval 20 feet.

MAP
SHOWING
OUTCROP
AND
EXTENT
OF
WAYNESBURG
COAL
IN
HARRISON
NORTHERN BELMONT
AND
SOUTHWESTERN
JEFFERSON
COUNTIES
OHIO

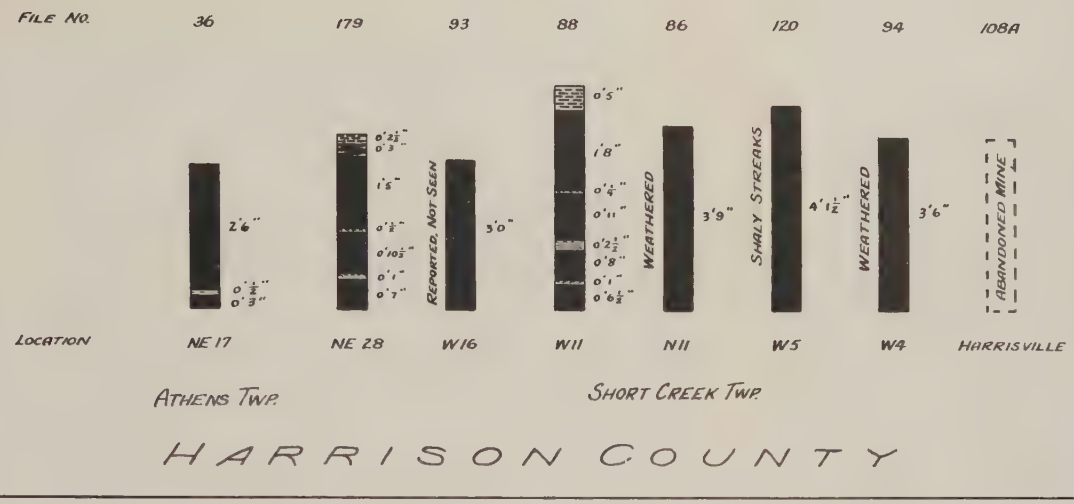
1070 Elevation of outcrop of Waynesburg coal.

(190) Location of section shown on Plate 2 measured by G. W. White.

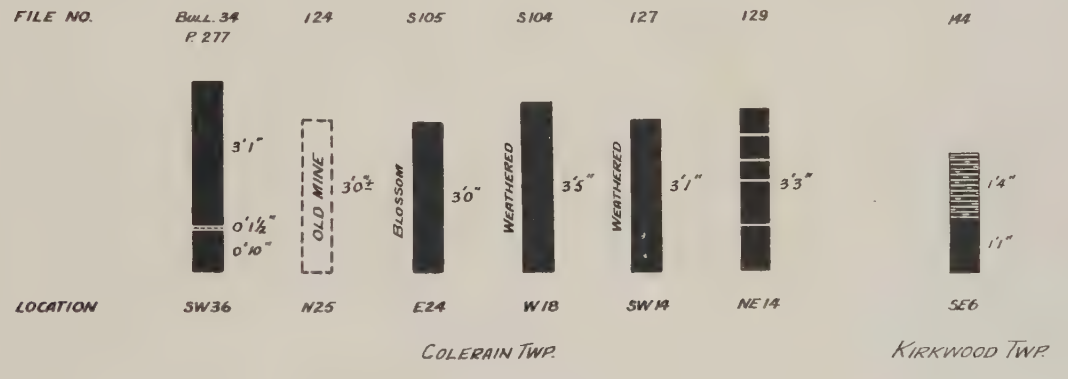
(S212) Location of section measured by W. Stout.

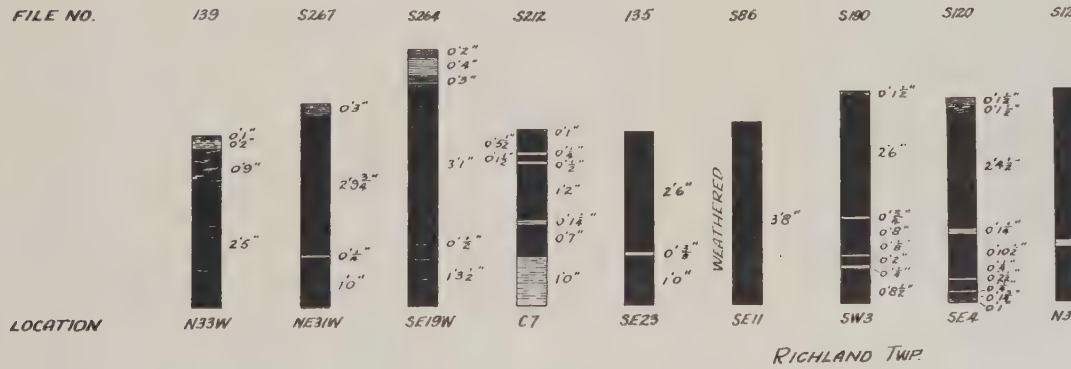
GEOLOGICAL SURVEY OF OHIO
1946

Plate 1



HARRISON COUNTY





BELMONT COUN

SECTIONS OF WAYNESBURG COAL IN H

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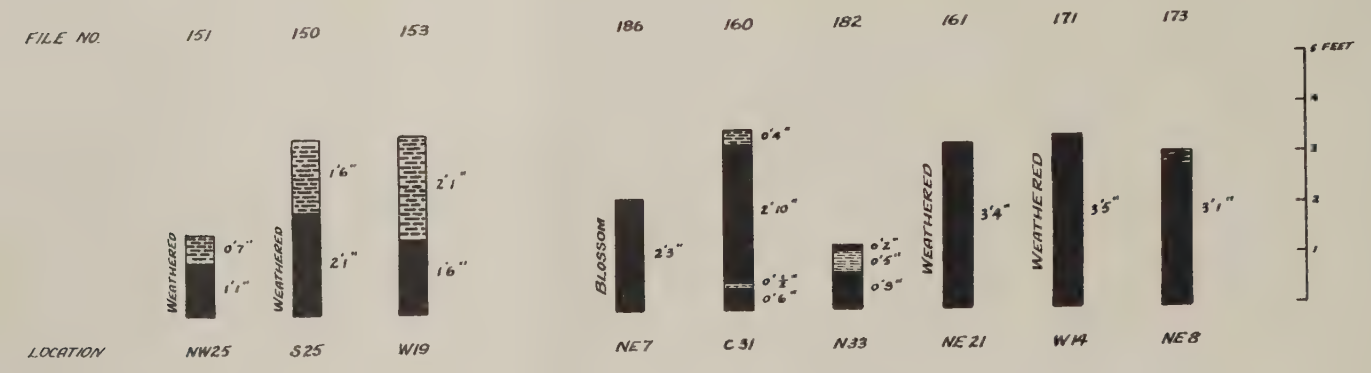
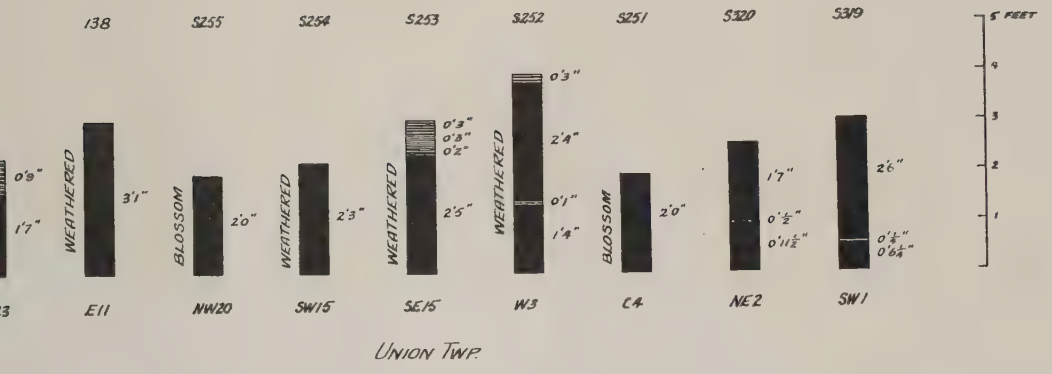
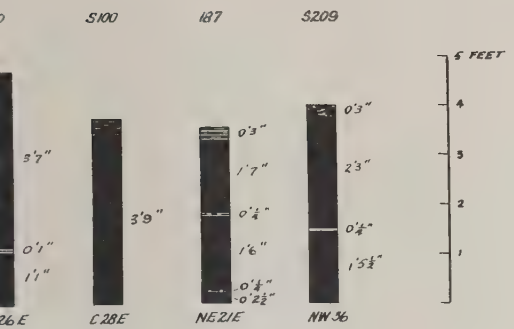






EXPLANATION

- Coal
- Shaly or Bony Coal
- Carbonaceous Shale
- Shale

Locations shown by file number on map Plate I

GEOLOGICAL SURVEY OF OHIO
1946

T Y

ARRISON AND NORTHERN BELMONT COUNTIES

Plate II

154½, 98, and 44½ feet respectively. Northward, in Colerain Township, the intervals are essentially similar to those at Blaine Hill. Farther northward, in Sect. 11, Mt. Pleasant Township, Jefferson County,[9] the Waynesburg is 224 feet above the Pittsburgh and 142 feet above the Meigs Creek. To the northwest of Blaine Hill, in southeastern Harrison County, in W. Sect. 4 and N. Sect. 11, Short Creek Township (94 and 86, Plate I, and Fig. 2) the intervals are reduced. In W. Sect. 28 of the same township the Meigs Creek-Waynesburg interval is similar (91, Fig. 2, three-eighths mile south of 179 of Plate I). Farther west, in N.E. Sect. 17, Athens Township, Harrison County (36, Plate I, and Fig. 2), the intervals are still less. Here the Waynesburg lies closer to the Pittsburgh coal than does the Uniontown at Blaine Hill. An analysis of Fig. 2 shows that the reduction in the Waynesburg-Pittsburgh interval from Blaine Hill northward is due solely to a lessening of the Waynesburg-Meigs Creek interval, and that the further reduction westward is due to a decrease of the Meigs Creek-Pittsburgh interval.

ELEVATION AND STRUCTURE

The Waynesburg coal outcrops at elevations ranging from 1,290 feet in Sect. 17, Athens Township, Harrison County, to 1,000 feet in Sect. 10, Colerain Township, Belmont County (Plate I). The general direction of dip is east-southeast, with local variations. The dip is only a few feet per mile in the northwestern part of the area but may reach 30 feet or more per mile in the southwestern part. As shown on the map, the member is found only in small areas on hill and ridge tops in the western and northern parts of the region, but is much more extensive and nearer the valley bottoms in the southeastern part.

THICKNESS AND CHARACTER

Within the region under discussion the Waynesburg coal varies in thickness from a few inches to almost 5 feet. Over considerable areas the thickness is 3 to 3½ feet. Plate II shows the thickness of the coal at each place designated by the corresponding stratigraphic section number of the map, Plate I.

The Waynesburg coal is a bright, banded, bituminous coal. This coal almost everywhere has one or more partings, which may be either clay shale or carbonaceous shale. The lower half of the bed usually, but not always, has more of these partings than the upper half. Partings are most numerous in Short Creek Township, Harrison County. In Flushing and Kirkwood townships, Belmont County, the upper part of the bed consists of carbonaceous shale rather than coal.

The Waynesburg coal in Mt. Pleasant Township, Jefferson County, has been described by Lamborn[10] as weathered blossom from 2 ft. 6 in. to 2 ft. 10 in. in thickness. It is probable that under cover the Waynesburg coal in parts of this township is 3 feet or more in thickness.

A sample of Waynesburg coal[11] was taken in 1927 by the writer and P. E. Fitzgerald from the local mine of A. B. Shields, S.W. ¼ Sect. 36, Colerain Township, Belmont County (B34, Plates I and II). Analysis by D. J. Demorest:

		Ft.	In.
Sandstone, massive.			
Sandstone, shaly		0	3
Coal, good, sampled	*Waynesburg*	3	1
Shale, dark, rejected		0	1½
Coal, good, sampled		0	9½
Shale, with pyrite bands, rejected		0	⅜
Coal, bony, rejected		0	2
Shale, gray, soft.			

[9]Lamborn, *op. cit.*, p. 33.

[10]Lamborn, *op. cit.*, pp. 252–253.

[11]Bownocker, J. A., and Dean, E. S., "Analyses of Coals of Ohio," *Geol. Survey Ohio Bull. 34*, p. 277, 1929.

Proximate analysis	As received	Moisture free
Moisture	5.27	0.00
Volatile matter	37.42	39.50
Fixed carbon	42.61	44.98
Ash	14.70	15.52
	100.00	100.00

Ultimate analysis	As received	Moisture free
Carbon	64.45	68.04
Hydrogen	4.97	4.62
Oxygen	12.25	7.99
Nitrogen	1.44	1.52
Sulphur	2.19	2.31
Ash	14.70	15.52
	100.00	100.00

Air drying loss 2.3 per cent.

		As received	Moisture free
Heating value	Calories	6,434	6,792
	B. t. u.	11,581	12,225
Fusion of ash	Incipient	2,583° F.	
	Complete	2,635° F.	

Ten other analyses of the Waynesburg coal[12] from Belmont County east and south of the region here discussed show this coal (as received) ranging from 1.78 to 5.72 moisture; 35.32 to 40.07 V. M.; 39.70 to 45.89 F. C.; 13.07 to 16.87 ash; 1.75 to 4.91 S.; and 11,000 to 12,020 B.t.u. From the analysis from Colerain Township the coal is high volatile bituminous B but close to the A range,[13] into which range falls at least one sample of Waynesburg coal,[14] that from central Sect. 36, Richland Township, Belmont County, (1 mile S.E. of S209, Plate I), just south of the region here discussed.

The roof of the Waynesburg coal is at most places shale, often sandy and ferruginous. In Harrison County the shale becomes more sandy upward and a few feet above the coal may pass into shaly sandstone. In much of Belmont County the roof material is shale, grading upward to shaly sandstone. In the eastern margin of the region from one to several feet of clay shale overlies the coal, the shale being overlain by the dense Elm Grove limestone,[15] which, however, is replaced by sandstone at places. On the whole, roof conditions for mining may be considered fair to good, except where the coal is under shallow covering and weathering has affected the roof strata.

The material beneath the coal is gray clay shale, at places having the appearance of a very impure fire clay. In thickness the clay shale varies from a few inches to several feet, 2 feet being about average. Below the clay shale is shale of coarser grain. Unless abnormally wet conditions obtained the material beneath Waynesburg coal should satisfactorily support mine props and tracks.

USE AND RESERVES

In Harrison County the Waynesburg coal has been mined in a small way on the farm of F. M. Price, W. Sect. 11, Short Creek Township (88, Plates I and II). The coal is reported to burn well in stoves, with considerable ash but without clinkers. The coal was mined many years ago in a small way on the north edge of Harrisville but the mine has long since been abandoned. No other use of the coal in Harrison County is known.

In Belmont County the coal has been mined in a few small operations for household use, all now inactive, in Colerain and Richland townships, and in other townships east and south of the region here discussed. With the exception of the removal of a very small amount of coal from these minor operations, the entire area of the Waynesburg coal shown in Plate I is part of the coal reserve of Ohio.

[12] *Ibid.*, pp. 277–283, 327–328.

[13] Fieldner, A. C., and others, "Classification Chart of Typical Coals of the United States," *U. S. Bur. Mines Rept. Inv. 3996R*, pp. 3, 5, 1939.

[14] Bownocker and Dean, *op. cit.*, pp. 277–278.

[15] White, G. W., *op. cit.*, p. 176.

PRODUCTION OF BALANCED SQUARE WAVES FOR ELECTRONIC STIMULATION

LEO S. GOLDSTON AND JOHN A. MILLER,
Department of Zoology and Entomology,
The Ohio State University

INTRODUCTION

It is generally recognized that integrated organisms have definite reactions to electronic currents. Animal reactions to electrical stimulation are related to the strength of the stimulus (voltage); the quantity of the stimulus (amperage), and the nature of the stimulus (wave form). Instantaneously interrupted electron currents have proven to be quantitatively applicable to behavior studies. The spaced sudden shock type of Hill (1934) or the controlled interruptions of direct current described by Ritchie (1944) are the conventional methods of current application for this type of work. The several devices which we present below produce a balanced square wave, i.e., an instantaneous interchange of cathode and anode at a controlled tempo. With such electrical mechanisms it is possible through synchronization of movement with wave form to quantitatively interpret reactions to electron stimulation.

In the biological laboratory this instantaneous interchange may be accomplished by a double pole double throw (dpdt) hand switch. In a physics laboratory an electronic switch or square wave generator is used to accomplish the same result. With these types of mechanisms it is possible to effect an electrical stimulation, the electro-chemical results of which are equal and opposite.

METHODS OF PRODUCTION

With the common dpdt switch, the interchange is made at as slow a tempo as may be desired. Although we have the human element herein, it would be negligible in frequencies of one interchange every several seconds. This method of production is shown in Fig. 1. It was determined, however, that frequencies beyond the accuracy range of the dpdt switch were required in the behavior laboratory.

To produce controlled frequencies accurately between .25 and 5 cycles per second, a special mechanism was designed. This consists of a variable speed motor with an external commutator which excites a dpdt electric relay. With such a device voltage as well as frequency may be varied. See Fig. 2 for details.

To produce controlled frequencies of a higher range (5 to 100,000 cycles per second) a variable square wave generator is used. With such a device it is also possible to accurately control both frequency and output voltage. An oscillograph when employed in the circuit provides a visual check on wave form, frequency and voltage. See Fig. 3 for details.

INTERPRETATION

The variable speed motor with an external commutator activating a dpdt relay produces an instantaneous interchange with satisfactory accuracy at lower frequencies. The calculation of frequency output from this mechanism is based upon the revolutions per minute of the commutator. At low speeds this can be reasonably determined by a stop watch, higher speeds requiring either a RPM meter or an oscillograph for visual observation.

As previously stated, a variable square wave generator provides with accuracy variable frequencies in the higher range. A relatively accurate check of the

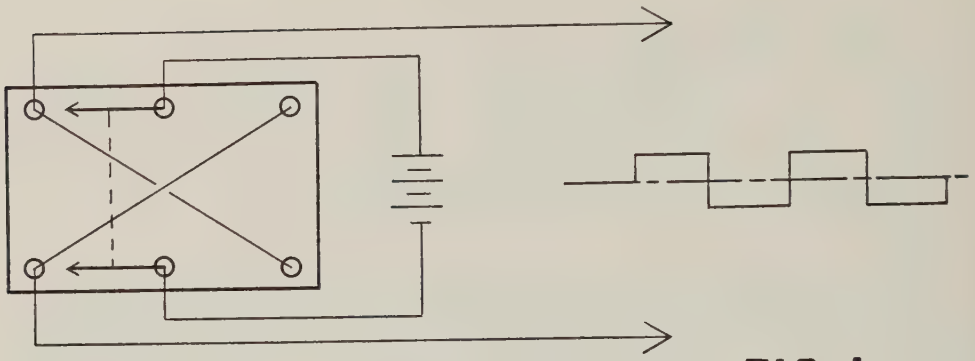


FIG. 1

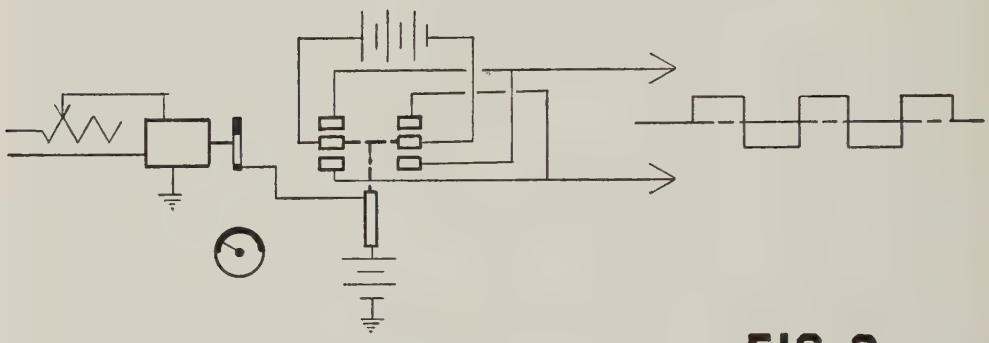


FIG. 2

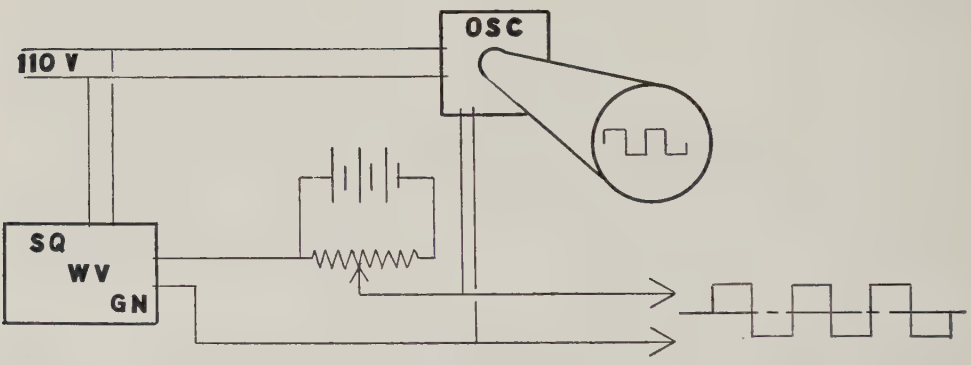


FIG. 3

FIG. 1. Hand operated double pole double throw switch.

FIG. 2. Variable speed motor with external commutator exciting a double pole double throw electric relay.

FIG. 3. Variable square wave generator, with balancing batteries and oscillograph.

calibrated output may be made through the use of an oscillograph after synchronization with a known frequency. Utilization of the direct deflection plates of the oscillograph makes it possible to visually determine voltage reference level and output. The reference level may be set to ground through the use of balancing batteries (Fig. 3).

The oscillograph employed in the above circuit has its sweep synchronized to a known frequency. Interpretation of any higher harmonic is then possible by direct count of cycles shown on the screen of the cathode ray tube.

APPLICATION

The above described apparatus provides a means of applying electrical stimulation of known frequencies. Interesting results were obtained using Protozoa as test organisms and will be reported in an early issue of this Journal.

REFERENCES

Hill, A. V. 1934. Repetitive stimulation by commutator and condenser. Jour. Physiol., 82: 4.
Ritchie, A. E. 1944. A simple variable "square wave" stimulator by biological work. Jour. Sci. Instruments, 21: 4.

Genetics is a Mathematical Science

The early work of Hardy, Weinberg and Jennings laid the groundwork for clarifying the statistical implications of the theory of the gene. On this basis has been built a formidable superstructure of mathematical analysis of many types of genetical problems. Among the important problems analyzed in this way are those associated with systems of mating, particularly in agriculture, with evolution, and with human genetics. Dr. Hogben, a noted elucidator of mathematical theory, attempts in this book to make clear the statistical and mathematical ideology underlying modern genetics. It appears to this reviewer that Hogben has been less successful in this attempt than in some of his previous books on other phases of arithmetic. The book is not easy reading, in spite of the essential simplicity of the material covered. Frequently the reader is more muddled at the end of a chapter than he was at the start. Nevertheless there is much of value to be gleaned from the book by careful winnowing. Of particular importance are the chapters on mutation and selection pressures, and on non-assortative and assortative mating. Here the direct connection with genetics and evolution is more evident, and the reader's interest is more steadily maintained. The book is recommended as a reference work for those who are satistically minded. Exercises are provided at the ends of the various sections, and the answers to the exercises are also made available. Two appendices discuss significance tests for Mendelian ratios, and maximum likelihood methods of analyzing various genetic experiments. An excellent index completes the volume.—*L. H. Snyder.*

An Introduction to Mathematical Genetics, by Lancelot Hogben. xii+260 pp. New York, W. W. Norton and Co., Inc. 1946.

WHAT IS EMOTION?

HORACE B. ENGLISH,
The Ohio State University

Emotion is one of those terms we use so familiarly that we seldom ask what they really mean. Let the reader try to compose a definition which would help anyone to identify the phenomena referred to. Let him see how little help is to be found in a dictionary.

The difficulty is not entirely due to ignorance. We now have an astonishing welter of detailed fact about emotional behavior, particularly in childhood and in many abnormal conditions. When, however, we try to organize these facts in a coherent pattern, we run into many perplexities. Indeed some psychologists believe that the kinds of behavior traditionally called emotional are so diverse that they cannot be usefully treated together. This article is an attempt, however, to classify these behaviors in a meaningful way and for the intelligent layman.

A useful treatment of the subject must begin, however, by changing the form of question usually asked. The older psychology began by asking "what is in our consciousness or mind during emotion?" This approach has on the whole proved rather sterile, particularly in child psychology. Contemporary scientific psychology no longer asks about the "contents of consciousness" nor even about "what's in your mind" (though the Freudian movement unfortunately often uses such a phraseology). Instead, it asks what people do and why and how. We must ask, then, what it is that we *do* when we emote.

The verb, to emote, finds no place as yet in the dictionary. Such a term is, however, sadly needed, not only for its convenience but in recognition of the shift in emphasis in psychology from a study of "mental contents" (represented by nouns) to a study of activities (best represented by verbs). When old terms fail to express our meaning, we have two choices: to put forward a neologism constructed according to etymological "rules," or to hunt for an acceptable current expression. The fact that "emote" is already in wide use as slang and is immediately understood indicates that it is in accord with the genius of the language. The step from slang to propriety should therefore be easy—and much preferable to the invention of a term which would need not only defense but explanation.

THE COMPONENTS OF EMOTING

Emoting, it is sufficiently obvious, is a complex tangle of personal activities. Our initial task is therefore to seek the component parts of this complex behavior.

1. The first thing we do when we emote—at least, usually—is to perceive or imagine the emotive situation or object. This is so obvious that it is usually ignored—to the serious damage of our thinking about the subject. Perhaps this is because in emotion we often do not specifically attend to the object nor think about it; and sometimes we do not even realize that it is this object with which our emoting is connected. But awareness of the emotive situation does happen.

2. Then we do something to *alter* or *control* the external circumstances which constitute the emotive situation. If we consider an object fearsome, we flee from it or endeavor in some other way to rid ourselves of it. If we are angry we no less obviously endeavor to alter the object or situation by "attacking" it. If our feeling is of the pleasant variety our effort may be rather to maintain and cherish than to remove the object of emoting. Yet even here we also "alter" it—as when we eat a luscious tidbit or pet a cat or dog. In all cases we make, or at least tend to make, an objective or *external adaptation* or *adjustment*, an adjustment directed toward the emotive situation or some object in it.

In the infant these movements of external adaptation are very confused and chaotic, and differ little from one sort of situation to another. Even so, there is activity directed outward upon the environment, as when an obnoxious stimulus leads to squirming or thrashing about. As the child grows older, the action tends to becomes less "all-over," more precisely adjusted to the kind of situation, more differentiated and adaptive. But always there is a great deal of ill-coordinated movement in emoting. These external adjustments are accomplished by tugging at our bones with the so-called striped muscles. Many psychologists have therefore followed the lead of the anatomist and physiologist in calling them skeletal responses; since, however, there are other skeletal responses with a somewhat different function, the usage is rather unfortunate as far as psychology is concerned.

Not to recognize these outwardly directed actions as an *essential* part of emotional behavior is to lose an important clue to understanding the problem. Particularly is this true in childhood. Unfortunately, such recognition is not always forthcoming. Laymen and psychologists alike often speak of these responses as if they were something tacked on, a sort of result or sequel of emotion. As we shall see later, this leaves us with an incomplete picture.

3. The ancients localized the several emotions in the internal organs: the heart was the organ of love, the spleen of anger, the bowels of pity and yearning, and so on. They were partly correct. What we may call the "Department of the Interior" must indeed be heard from. In every emoting some at least of our glands (of which we now hear so much) are directly involved; and, since the glands are intimately interconnected, it is probable that nearly all of them are active in some way in each case.

Then, too, the muscles of the genito-urinary tract, and those lining the walls of the digestive tract—"smooth" muscles the anatomist calls them—are involved in characteristic ways. The diaphragm and breathing are affected, and there are striking changes in the circulation of the blood in response to varied heart action and to changes in the tension of the arterial walls in different parts of the body. Even when emoting rather mildly we are apt to be considerably "stirred up inside."

Psychologically, these responses may be considered as a sort of *internal adaptation* to the emotive situation just as the skeletal responses constitute an external adjustment. There is much controversy, however, as to whether these internal responses should be considered adjustive or helpful. In some cases they seem to prepare the individual for external adjustments to come. In other cases, however, the internal responses, especially if violent, tend to interfere with and disrupt the external adjustment. Our own use of the term adaptation is not intended to prejudge the issue as to whether the internal response is helpful. It merely calls attention to the fact that these internal reactions are changes in the individual with reference to the emotive situation, and hence are a sort of adaptation to it, though possibly not a good one. Nearly all of these reactions are controlled by the autonomic nervous system, and some writers therefore call this aspect of emoting "autonomic response." But there are other autonomic activities, which, so far as we know, play no part in emoting, so the usage is a little dubious. The term "visceral response," which is even more common, is open to the same objection. Moreover, arterial changes are not strictly visceral. We prefer the term "internal responses."

4. For the next class of responses which we make when emoting, we may follow an old tradition in speaking of the "*expressive movements.*" To this class belong scowling, smiling, tightening the jaw, clenching teeth or fist, gesturing, perspiring, blushing, blanching, gooseflesh, and various tense and relaxed postures. Here also belong verbal interjections: groans, sighs, exclamations of surprise, pain, anger, or horror; and cries of pleasure and joy as well.

All these are usually called expressions of emotion as if the emotion were one thing and the expressions another. But these responses are truly *part* of what we do when emoting, not something distinct or added on. Indeed no emotion is quite complete without them. Try, for example, to enjoy a beautiful scene or great music without making any such reactions. Or note how great fear is lessened if there are few "expressions" of fear.

Darwin believed that all these "expressions" were vestiges of earlier adaptive responses—we bare the teeth in anger, he thought, because we are getting ready literally to bite. Today few accept his view except in a very general form. These responses serve our adaptation to the emotive situation in a quite different way. Essentially they are a sort of *emotional language* and work upon other persons in the situation. The bared teeth may frighten off the anger-arousing person, the cry of pain may bring help or enlist sympathy. The expressive reactions are primarily social adjustments.

5. Similarly social are certain forms of *verbal activity* which form part of emotional behavior. We threaten, cajole, plead, banter, verbally caress, coax, command, and otherwise attempt by our words to influence the persons who form part of our emotional situation. Such verbal conduct while very similar to the interjections of section 4, is not so primitive as other parts of emotion and often seems not to integrate or "tie in" closely with the rest. For this reason it seems better to make a distinct class for it. No catalog of the forms of emotional activity would, however, be complete without listing these language responses.

6. Lastly, we may distinguish an important but little regarded group of responses. This is the verbal response of naming the emotional behavior. This naming is not always audible; we say to ourselves: "Oh, I'm so happy," "Angry enough to bite nails," "Down-in-the-mouth." Infants and animals of course have no such reactions and they are often lacking in children or adults. Indeed sometimes we cannot name our feelings at all, somewhat to our discomfiture. But what we may call the "*secondary naming*" is a genuine part of many emotional behaviors.

Readers with some acquaintance with physiology and anatomy may be distressed by the proposed classification of emotional behaviors. These sciences recognize three broad classes of reaction: those of the striped or skeletal muscles, those of the smooth muscles, and those of the glands of internal or external secretion. Our classification obviously cuts clear across this pattern. The external adjustment responses of our Class 2 are skeletal, but do not include all of the skeletal movements. The internal adjustment of Class 3 includes smooth muscle responses and both types of glandular responses; but again it is very doubtful that all such responses are involved in emoting. As for the expressive movements (Class 4), here is, *physiologically* considered, confusion for sure: skeletal responses (as in clenching the fist or scowling), smooth muscles (as in blushing), and glands of external secretion (as in dry mouth, weeping, perspiring). Some of these reactions belong to the cerebro-spinal system, some to the autonomic. Vocalizing behavior, which is skeletal for the physiologist, is found in no less than three of our classes. As for our first class, the perceiving of the emotive situation, no one really knows very much as to what, in physiological terms, is going on beyond the activity of the sense organs immediately involved.

Actually such a difference between the way facts are classified in two sciences should occasion neither surprise nor concern. Every science necessarily has its own structure. The *facts* discovered in one science must be accepted by all other sciences; but the classification of the facts depends upon what one is trying to do. Indeed, the importation into a science of the concepts of another is apt to be dangerous. The unity of science is the unity of *common facts* and a *common logic*, not of a common conceptual framework.

THE DIFFERENCE BETWEEN EMOTING AND OTHER ACTIONS

Here, then, are six ways of acting which in their totality constitute emoting. But what other acts do *not* show exactly the same classes of behavior? When, for example, one calmly drives an auto through a crowded street, copies a drawing of a gear wheel, or studies how to persuade the boss to give one a raise, one is not ordinarily thought of as acting emotionally, yet each of the six classes of action listed above is involved (or at least may be) in these non-emotional acts.

We could, at this point, fall back on the truism that we probably never act at all without emoting a little bit, but that would be something of an evasion. It is a fair demand that we differentiate between what we ordinarily call emotional and non-emotional action, and our analysis leaves the way open for just that differentiation. *Emoting is a complex and extended way of acting in which behavior is dominated by or integrated around the activities of internal adjustment.*

Indeed the internal or so-called visceral responses often dominate the stage so thoroughly that we tend to over-estimate their role, even to identify emoting with just that one aspect. This is a mistake. The internal component is truly a *necessary* part of any behavior we call emotional and the other parts are organized around it; but it is never the whole act.

In the first place, if we do not perceive or imagine the stimulating circumstances, the whole drama fails to unroll. The "uncaused" fears sometimes found in the insane are probably no exception, since the patient is probably reacting, directly or indirectly, to some obscure imaginary situation which he cannot name or describe. Moreover, the end of emoting comes, not when the situation actually changes, but when we perceive it in a different way.

A second difficulty is that the internal responses of different emotions seem so extraordinarily alike. Neither to introspection nor to objective measurement does the internal reaction of fear differ materially from that of anger; and the more we know about the two ways of emoting the more alike the internal responses seem to be. As far as internal adjustment goes, we seem to have but two kinds of emoting: a plus or favoring kind and a minus or rejecting kind. Now to reduce all emotion to just two certainly cannot do justice to the variety of feelings which mankind has so long celebrated in song and story; and the subtle variations are not something just tacked on but an intrinsic part of the whole pattern. To identify emoting with just its central core of internal responses is to miss the factors which differentiate one feeling from another.

Finally, to identify emoting with the internal response is to imply that the latter has significance all by itself. That is not the case. The internal reaction must be seen in relation with the other components if "emotion" is to make sense. A merely internal adaptation of a person without at least a tendency toward external adjustment—be it physical or social—is almost unthinkable, and if it were thinkable would be most injudicious. However central the internal adjustment is in emoting, we must not ignore the other components with which it is inseparably joined.

EMOTING AS AN INTEGRATION

Some of you may be inclined at this point to object to the analysis as incomplete. It is like *Hamlet* without the Prince of Denmark. What, you may ask, about the feelings, the emotions themselves? Are not all these bodily activities which we have been talking about merely the accompaniments of the emotion? No one questions, you add, that all these physiological functions of gland and muscle are somehow involved in emotion, but to say they *are* emotion is to leave out the mental or spiritual aspect which is the most important of all.

Well, it is not possible to be dogmatic here. All one can do is to ask that the objection be clearly stated. Just where *is* the feeling we have so far omitted?

Or rather, how do we do it? For it is to be remembered that our question is, What do we *do* when we emote? To say that we run, that we blush, that we exclaim, that we get all stirred up in what the Scotch call our "insides"—that is intelligible and demonstrable. Is there anything else that we do? If so, what is it?

Note that this way of looking at the matter does not deny at all that there is a specific way of acting called fearing or loving or being anxious or disgusted. It just says that fearing is the *sum-total*, or better, the *integration* of the things we demonstrably do when we fear. Joy, likewise, is just the particular combination of things done, or rather of "doings." A particular emoting, that is to say, is not something over and above the ways of acting we have listed; these in their totality *are* the emoting. Fear and anger and disgust and joy and love and happiness are simply *you in action* in as many different ways.

To say this, moreover, is not to deny to emoting spiritual value. On the contrary, to think of anger or fear or joy as *particular ways of living* seems a much richer concept than to think of them as some sort of "mental content" locked up in each individual's mind and inaccessible to anyone else save indirectly. Joy remains joy no matter how it is analyzed. Even though it be shown that what we do when we are happy is to integrate certain adaptive big-muscle movements, certain internal reactions, and certain verbal activities, happiness remains the chief, if not the only, source of human values.

We do not wish, however, to close the door to any facts. The foregoing analysis may not be complete; the way is open to any addition of a demonstrable mode of acting which takes place when we emote. The virtue of our analysis consists chiefly in that it provides us with convenient pegs whereon to hang facts of considerable value to those who must deal with the emotional problems of themselves and others.

Insect Microbiology

This book treats the various associations and relationships existing between all types of microbes and insects (including ticks and mites) from a biologic viewpoint. It is essentially a compilation of widely scattered data on this important subject but much of these data have not been sufficiently studied to present adequate bases for discussions relating to the biologic relationships involved. By the bringing together of this information into one volume and pointing out places where insufficient knowledge is lacking, advances in this phase of science should now be more rapid. It is through researches of this type that all branches of science are ultimately benefited. The writer is to be commended for this contribution which should be a valuable aid to the teachers and research workers in biological sciences but especially the medical entomologist, pathologist and bacteriologist.

Following the preface and introduction the subjects treated by chapters are as follows: Extracellular Bacteria and Insects; Specific Bacteria Associated with Insects; Intracellular Bacterium-like and Rickettsialike Symbiotes; Rickettsiae; Yeasts and Insects; Fungi and Insects; Viruses and Insects; Spirochetes Associated with Insects and Ticks; Protozoa and Insects (except termites); Protozoa in Termites; Immunity in Insects; and Methods and Procedures.

There are 87 pages of references indicating the enormous amount of material reviewed in preparing the book. The 250 text figures, an author index and subject index complete the book.—R. H. D.

Insect Microbiology, by Edward A. Steinhaus. Comstock Publishing Company, Ithaca, N. Y. x+173 pp. 1945. Price, $7.75.

OHIO ROBBER FLIES IV

(Diptera: Asilidae)

STANLEY W. BROMLEY,
Bartlett Tree Research Laboratories,
Stamford, Conn.

With the passing years a number of new Asilid records for the State of Ohio have accrued. My "Preliminary Annotated List of the Robber Flies of Ohio" was published November 1, 1931, by the Ohio State Archaeological and Historical Society. This publication listed a total of 65 species of this group of flies for Ohio. Subsequently "Additions to the Ohio List of Robber Flies," published in the *Ohio Journal of Science*, vol. 33, no. 3, May, 1933, listed 5 more; "Additions to the Ohio List of Robber Flies II," *Ohio Journal of Science*, vol. 34, no. 3, May, 1934, listed 4 more and "Additions to the Ohio List of Robber Flies III," *Ohio Journal of Science*, vol. 36, no. 3, May, 1936, listed 3 more, making a total of 77 species as of 1936.

Since then, 13 more species, the specimens now incorporated in the Ohio State Museum collection (Dr. E. S. Thomas in charge) or in the Ohio State University collection in the Botany and Zoology Building (Dr. Josef Knull in charge) have been added.

78. **Dioctria baumhaueri** Meigen. Columbus, Franklin County, June 27, 1937, collected by C. L. Ward. This is our only introduced Asilid—a common European species first found in this country at Boston, Massachusetts, in 1916 by C. W. Johnson.
79. **Cyrtopogon laphriformis** Curran. Hocking County, Ohio, May 23. D. J. and J. N. Knull. A beautiful grayish species with orange pile on the abdomen.
80. **Laphria ithypyga** McAtee. Seven males, two females, Lancaster, June 15–27, 1943 and 1944. R. M. Goslin.
    Of the same size and appearance as *index* McAtee, but differs in the structure of the male genitalia.
81. **Asilus maneei** Hine. Mound City, August 10, 1941, R. M. Goslin, E. S. Thomas and S. W. Bromley. Eleven specimens collected.
    A small blackish-gray species usually found resting on tree trunks.
82. **Leptogaster tenuipes** Loew. Two females, July 22, 1944, Alum Creek, Columbus. R. M. Goslin.
83. **Leptogaster virgatus** Coquillett. Ross County, Colerain Township, June 21, 1936. R. M. Goslin.
84. **Ceraturgus dimidiatus** Macquart. Three males, two females, Wooster, Wayne County, June 15, 1937. Dale Jenkins and D. J. Borror. A male East Union, Wayne County, same date.
    Holmesville, Holmes County, 2 males, 2 females, June 15–20, 1937. R. T. Everly.
85. **Bombomima posticata** Say. Hocking County, "Neotoma," May 24, 1936. E. S. Thomas. Same locality, June 6, 1936. D. W. Jenkins.
86. **Cerotainia albipilosa** Curran. Athens, July 20. W. C. Stehr. I doubt if this is specifically distinct from *C. macrocera* Say.
87. **Leptogaster favillaceus** Loew. Newark, June 17, 1931. R. M. Goslin. Colerain, Ross County, June 13, 1937. R. M. Goslin.
88. **Leptogaster eudicranus** Loew. Delaware County, July 4. D. J. & J. N. Knull.
89. **Asilus virginicus** Banks. "Neotoma," Hocking County, June 6, 1937. E. S. Thomas.
90. **Asilus erythocnemius** Hine. Columbus, University Farm, August 5, 1943. Howard W. Smith.

Another individual of the excessively rare *Dasylechia atrox* Williston was taken on the O. S. U. Campus in Columbus flying around inside the class room in the Botany and Zoology Building on July 5, 1942, by R. W. Strandtmann.

Certain Asilids kill honey-bees and are known as "Bee-Killers." Twelve species have been taken with honey-bee prey in Ohio, but in no case were the flies sufficiently numerous to cause economic losses to apiarists.

Bee-killers	Number of honey-bee prey
1. *Promachus vertebratus* Say	28
2. *Mallophora orcina* Wied	21
3. *Diogmites discolor* Loew	17
4. *Promachus bastardii* Macq	15
5. *Diogmites umbrinus* Loew	9
6. *Bombomima thoracica* Fabr	9
7. *Promachus hinei* Bromley	8
8. *Proctacanthus milbertii* Macq	4
9. *Proctacanthus hinei* Bromley	4
10. *Proctacanthus duryi* Hine	4
11. *Promachus rufipes* Fabr	1
12. *Erax aestuans* L	1

Three species in the environs of Columbus were seen killing the honey-bee. These were *Bombomima thoracica* Fabr. found along the sunny edges of woods, orchards and around bee hives in May and June; *Diogmites discolor* Loew around rank herbage, flower gardens, edges of fields and woods, and in apiaries during July and August; and *Promachus vertebratus* Say which occurs in clover fields, and iron-weed swales and pastures during August and early September.

Bombomima thoracica Fabr. is a remarkable mimic of a female bumblebee and is the insect to which many bee-keepers refer when speaking of the "bumble-bee" that catches honey bees.

In the Hocking Hills, 25 or 30 miles to the Southeast of Columbus, two other bee-killers, in addition to the three above mentioned, are common. These are *Diogmites umbrinus* Loew and *Promachus bastardi* Macquart. Both frequently haunt apiaries.

In the Cincinnati area, in addition to the five preceding species, there are three more, important bee-killers: *Mallophora orcina* Wied., the notorious "Southern Bee-killer," occurring in flower gardens, Joe-Pye weed swales, and around apiaries; *Proctacanthus milbertii* Macquart, the so-called "Missouri Bee-killer," which actually feeds largely on grasshoppers and butterflies in old sandy Andropogon and goldenrod fields, only occasionally taking honey-bees; and *Promachus hinei* Bromley, a large powerful robber fly frequently seen alighting on fence posts or barbed wire along cultivated fields in low ground, swales, among moist or rank herbage, or in low open woodlands in alluvial somewhat sandy soil.

The large red *Proctacanthus hinei* Bromley is found in sandy areas along Lake Erie and the Ohio River, while the smaller tan-colored *Proctacanthus duryi* Hine occurs in similar situations along the Ohio River. Both are Bee-killers.

The two remaining species, each with a single honeybee record are worthy of comment. *Promachus rufipes* Fabr., the so-called "Bee Panther," common in the South Atlantic coastal region, is rare in Ohio and confined to the Southeastern part of the State, while *Erax aestuans* L. is a very common summer Asilid throughout most of the State. *E. aestuans* feeds largely on small Diptera, being particularly fond of house and stable flies, and its capture of honey-bees is a rare occurrence.

NEW NORTH AMERICAN COLEOPTERA)
(Buprestidae, Schizopodidae and Cerambycidae)

J. N. KNULL,
Department of Zoology and Entomology,
The Ohio State University

Juniperella n. g.

Head convex, wider on front than on vertex; front not narrowed by insertion of antennae; epistoma broadly emarginate in front; antennal cavities small, round, situated near lower portion of eyes; antennae not reaching hind angles of pronotum when laid along side; scape narrow, elongate, cylindrical; second segment about twice as long as wide, cylindrical; segments four to ten inclusive elongate, flattened, serrate; last segment elongate, narrower than preceding segments.

Pronotum twice as wide as long, widest at base; side margin extending to middle; disk convex, without callosities. Scutellum small.

Elytra at base wider than pronotum, widest back of middle.

Prosternum convex, anterior margin truncate, prosternal process slightly expanded back of coxal cavities, acuminate at apex. Suture of mesosternum quite indistinct.

Posterior coxal plates only slightly dilated internally, posterior margin nearly straight, cut off externally by abdomen; epimera of metathorax uncovered, triangular; mesosternum and metasternum closely united, suture fine.

Legs slender, tibiae straight, subcylindrical; tarsi slender, posterior tarsi only slightly longer than those on other two pairs of legs, fourth segment not lobed, claws normal.

Genotype: *Juniperella mirabilis* n. sp.

This genus should be placed in the *Buprestini* next to *Buprestis*. It is more robust and convex, prosternal process acuminate at apex, and sides of coxal plates more parallel.

Juniperella mirabilis n. sp.
(Fig. 2)

Short, very robust, shining; head, prothorax and scutellum bright metallic green; elytra dark green with four transverse, wide yellow bands not reaching suture; short pubescence on head and ventral surface only.

Head convex, densely, rather coarsely punctured.

Pronotum twice as wide as long, wider at base than at apex; sides broadly rounded from base to apex; anterior margin sinuate, median lobe small; posterior margin more strongly sinuate, median lobe broad; disk convex, slight depression in front of scutellum; surface densely, coarsely punctured, punctures closer on sides, larger than on head. Scutellum small, rounded in rear.

Elytra at base wider than pronotum, widest back of middle; sides subparallel near base, expanded back of middle, then broadly rounded to suture, forming an obtuse angle; margin serrulate near apex; disk convex, depressions lacking; surface glabrous, with very faint traces of costae, minute punctures dense.

Abdomen beneath densely, coarsely punctured; last visible abdominal segment more coarsely punctured; sides serrulate; strongly converging, apex truncate.

Length, 19 mm.; width, 8.5 mm.

Holotype of undetermined sex, collected from juniper (*Juniperus californica* Carr.) at 4,000 ft. elevation in Santa Rosa Mountains, California, June 25, 1946, by D. J. & J. N. Knull. Holotype in collection of author.

On branch where adult was taken was a fresh emergence hole which leads writer to believe that this is the species which breeds in living junipers in that locality. Eggs are evidently laid near base of tree and young larvae work in the roots. When a larva nearly reaches maturity it travels up the trunk from four inches to as high as three feet boring under bark and channeling

outer sapwood. A pupal cell is constructed in sapwood and the oval opening which is tightly plugged with fine granular frass is transverse with grain of the wood. All work goes on under the shreddy bark and until the emergence hole appears it is difficult to find infested trees. Trees containing work are usually in very unhealthy condition.

Hesperorhipis hyperbolus californicus n. subsp.
Figs. 4 and 5

Male.—Differs from male of *hyperbolus* Knull by having dark area at base of elytra more metallic green, or blue, than head and pronotum and light median area of elytron not extending up around inside of umbone. Ventral surface of abdomen more rugose; last ventral segment more narrowly and deeply emarginate at apex.

Length, 4.7 mm.; width, 1.4 mm.

Described from a series collected at 4,000 ft. in Santa Rosa Mountains, California, June 5 and July 4, 1946, by D. J. & J. N. Knull. Holotype male and paratypes in collection of writer, paratype in collection of The Ohio State University.

Variations.—Length of specimens ranges from 4.7 mm. to 2.7 mm.

Chrysobothris santarosae n. sp.
Figs. 10 and 11

Male.—Robust, convex; head, prothorax and ventral surface dark, shining, cupreous; elytra darker, opaque.

Head convex; surface with longitudinal smooth carina on occiput which is striate in middle, joining similar smooth areas on each side of front, forming a Y, another smooth area below Y, area between callosities densely, irregularly, coarsely punctured; clypeus truncate, faintly emarginate in middle; antennae not extending to middle of pronotum when laid along side.

Pronotum convex, much wider than long, widest in middle; sides rounded; anterior margin only slightly lobed; basal margin strongly sinuate; surface densely coarsely punctured, punctures confluent at sides. Scutellum small, triangular.

Elytra at base wider than widest part of pronotum, not entirely covering abdomen, sides subparallel basally, broadly rounded back of middle to rounded apices, serrulate; disk convex, two basal depressions each side, void of costae; surface finely, densely punctate, punctures larger and denser along outer margin.

Abdomen beneath coarsely, densely punctured, last visible segment without serrations, broadly emarginate at apex, with ridge on apical half extending across apex. Prosternum with anterior margin broadly rounded, deflexed. Anterior femur with obtuse tooth serrulate on outer margin. Anterior and middle tibiae arcuate, unarmed.

Length, 10.7 mm.; width, 4.2 mm.

Described from a male specimen in the collection of writer taken at 3,500 feet in the Santa Rosa Mountains, California, on June 15, 1946, by D. J. & J. N. Knull.

According to Fisher's key[1] it would run to *C. platti* Caz. It differs by the dark color as well as the coarsely punctured pronotum with smooth intervals.

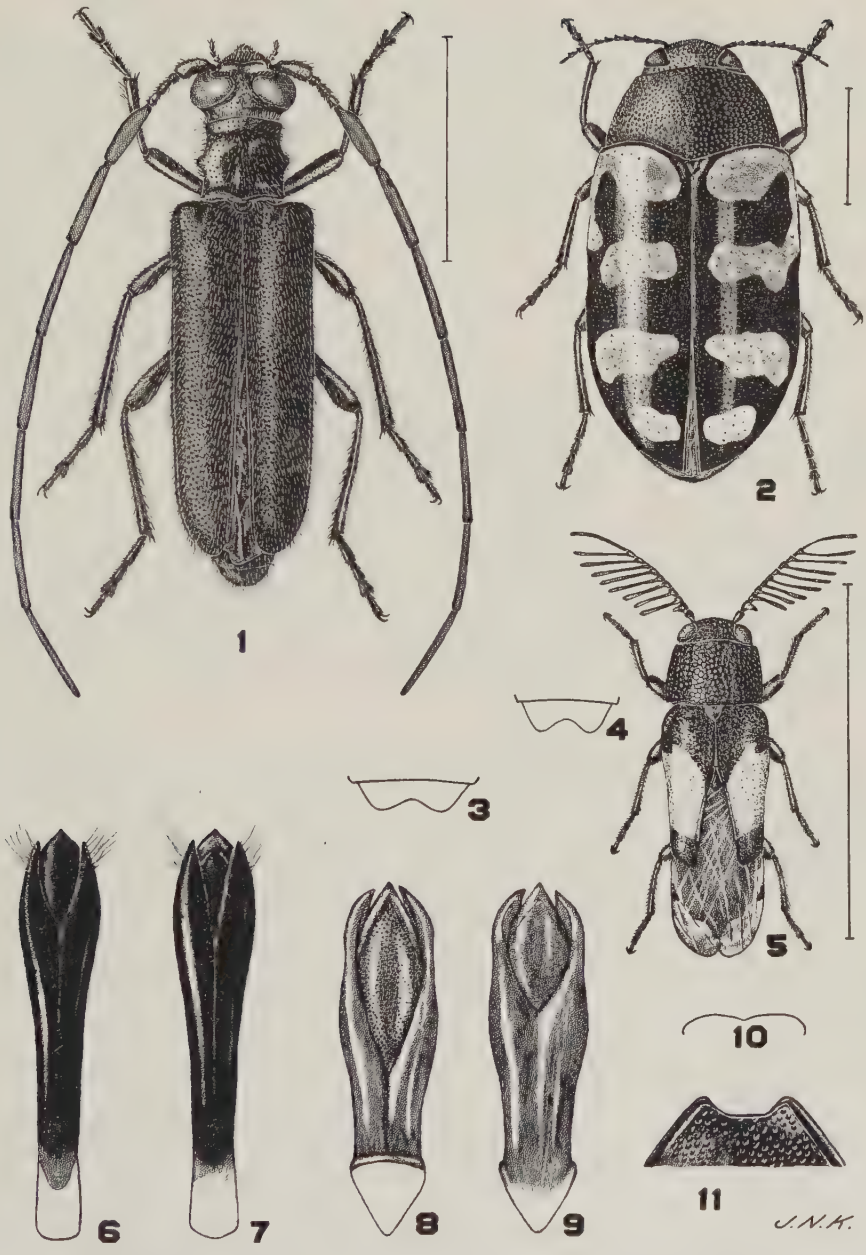
Agrilus gillespiensis n. sp.
Figs. 6 and 7

Male.—Narrow, elongate; form of *A. celti* Knull; dark bronze throughout, front of head metallic green.

Head convex, depression on vertex slight; surface granulose on front, finely strigate on vertex; antennae extending beyond middle of pronotum when laid along side, serrate from the fifth segment.

Pronotum wider than long, wider in front than in rear; side margins converging in front, sinuate near base; anterior margin sinuate, median lobe prominent; basal margin sinuate; disk convex, lateral depression each side, prehumeral carina nearly parallel to side margin; when viewed

[1]W. S. Fisher, U. S. D. A. Misc. Pub. 470, pp. 1–275, 1942.



1. *Centrodera osburni* n. sp. ♂. 2. *Juniperella mirabilis* n. sp. 3. *Hesperorhipis hyperbolus* Knull, last visible ventral abdominal segment. ♂. 4. *Hesperorhipis hyperbolus californicus* n. subsp., last visible ventral abdominal segment. ♂. 5. *Hesperorhipis hyperbolus californicus* n. subsp. ♂. 6. *Agrilus gillespiensis* n. sp., dorsal view of ♂ genitalia. 7. Ventral view of number 6. 8. *Chrysobothris santarosae* n. sp., dorsal view of ♂ genitalia. 9. Ventral view of number 8. 10. *Chrysobothris santarosae* n. sp., anterior margin of clypeus. 11. *Chrysobothris santarosae* n. sp., last visible ventral abdominal segment ♂.

Line equals 5 mm.

from side, marginal and submarginal carinae separated for entire distance, joined at base; surface finely, obliquely transversely strigose. Scutellum transversely carinate.

Elytra elongate, at base wider than base of pronotum; sides subparallel at base, constricted at middle, expanded back of middle, then converging to rounded, serrulate apices; disk convex, a basal depression each side, surface imbricate, pubescence inconspicuous.

Abdomen beneath minutely punctate, first ventral segment flattened in middle, flat area higher than second segment. Prosternum pubescent; prosternal lobe broadly rounded in front, lacking an emargination. Posterior coxal plates broadly emarginate in rear, outer posterior angle rectangular. Anterior and posterior tibiae mucronate on inner margin at apex. Tarsal claws similar, outer tooth long, acute; inner tooth short and broad.

Length, 5 mm.; width, 1.3 mm.

Female.—Differs from male by having front of head cupreous; first two ventral segments convex and tibiae unarmed at apices.

Holotype male and allotype collected in Gillespie Co., Texas, May 7, 1946, by D. J. & J. N. Knull and in collection of writer.

According to Fisher's key[2] this species would run to *A. celti* Knull. It differs by having lateral carinae of thorax separated for entire distance, prehumeral carina parallel to side margin, prosternal lobe broadly rounded, and shape of male genitalia.

Dystaxia murrayi cuprea n. subsp.

Female.—Size and form of *murrayi* Lec.; cupreous with green luster above and below; antennae, mouth parts and legs light brown. Compared with *murrayi* the anterior margin of epistoma is less deeply emarginate; antennae are shorter, extending one segment beyond hind angles of pronotum when laid along side, segments six to eleven inclusive proportionately shorter.

Length, 11.5 mm.; width, 6 mm.

Described from holotype female in collection of writer labeled Cajon Pass, California, June 26, 1941, D. J. & J. N. Knull collectors.

Gymnospyra notabilis n. sp.

Female.—Narrow, elongate; moderately shining, dark brown; legs and ventral surface lighter; head and pronotum with long, erect setae; elytra with densely recumbent pubescence, also scattered long erect setae.

Head convex, punctures large, confluent; eyes prominent, coarsely granulate; antennae not reaching end of abdomen when laid along side, scape stout, second segment slightly longer than wide, third shorter than scape, fourth longer than third, fifth longer than fourth, sixth equal to fifth, seventh shorter than sixth, eighth shorter than seventh, ninth equaling eighth, tenth shorter than ninth, eleventh longer than tenth, first four segments subcylindrical, densely coarsely punctured, segments five to ten inclusive somewhat flattened and slightly serrate, finely punctate.

Pronotum about as long as wide, widest in middle, base and apex of about equal width; sides broadly rounded, constricted at base and apex; anterior margin rounded; basal margin broadly emarginate; disk convex; surface densely, coarsely punctured. Scutellum transverse, broadly rounded in rear.

Elytra at base much wider than pronotum, elongate; sides subparallel, broadly rounded near apex to rounded apices; disk convex, a slight basal depression on each elytron; surface densely coarsely punctured at base, punctures becoming obsolete at apex, largest punctures much smaller than on pronotum.

Abdomen beneath shining, sparsely, finely punctate, pubescence long, slender. Anterior coxal cavities open behind, angled on outside; anterior tibiae carinate on outside.

Length, 13.7 mm.; width, 3.3 mm.

Holotype female in collection of writer labeled Jacumba, California, May 18, 1941, D. J. & J. N. Knull collectors.

This species appears to fit *Gymnospira* Lins. better than any other genus in our fauna, although it lacks antennal spines.

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[2]W. S. Fisher, U. S. National Mus. Bul. 145, pp. 1–347, 1928.

Centrodera osburni n. sp.
Fig. 1

Male.—Narrow, elongate; color dark brown throughout, shining, moderately pubescent.

Head wider than pronotum; surface coarsely punctured; eyes large, coarsely granulate; antennae extending two segments beyond apices of elytra when laid along side, scape stout, second segment as long as wide, third segment slightly longer than wide, longer than fourth, fifth as long as first three united, sixth longer than fifth, seventh and eighth equal, each longer than sixth, ninth and tenth equal, each shorter than eighth, eleventh longest, first four segments similar, shining, coarsely punctured, following segments flattened, opaque, minutely punctate.

Pronotum wider than long, widest in middle, base and apex of equal width; sides sinuate with rounded tubercle each side at middle; apical margin rounded; basal margin sinuate; disk convex, with transverse depression back of apex and at base, slight trace of median depression, rest of area somewhat irregular; surface coarsely, irregularly punctured all but middle line where punctures are small and sparse. Scutellum rounded in rear.

Elytra at base wider than head; sides subparallel, broadly rounded on apical fourth to rounded apices; disk convex, basal depression on each elytron shallow, lacking costae, surface rugulose, densely, finely punctured.

Abdomen beneath smooth, sparsely, finely punctate, densely punctured depressed area on each side of first four segments, last visible segment more densely punctured than others, truncate at apex. Tarsi on first two pairs of legs about equal, posterior tarsi slightly longer.

Length, 12.2 mm.; width, 3.5 mm.

Described from four male specimens collected at 6,000 ft. in the New York Mountains, California, September 11, 1945, by Dr. R. C. Osburn. Holotype and paratypes in collection of The Ohio State University, paratype in collection of writer.

This species can be distinguished by the short second, third and fourth antennal segments.

BACTERICIDAL EFFECT OF THE WAR-TIME PENNY

JOHN B. GERBERICH,[1]
Department of Zoology and Entomology,
The Ohio State University,
Columbus, Ohio

The copper penny has long been known to have bactericidal qualities and has been used in the classroom to illustrate such properties, likewise, it has been utilized in small aquaria and reservoirs for the purpose of inhibiting the growth of minute organisms. With the Government's issue of the new war-time penny a study was made to find if this coin produced similar effects and how they compared with those of the copper penny.

Both the copper penny and the war-time penny were placed upon sterile agar in a sterile Petri dish. The plate was exposed to the air for 15 minutes to assure bacterial inoculation. All the dishes remained at room temperatures for the entire experiment. Measurements of the inhibiting zone (Table I) and photographs (Fig. 1) of the plates were recorded at the following intervals: 72 hours, 144 hours, and 240 hours..

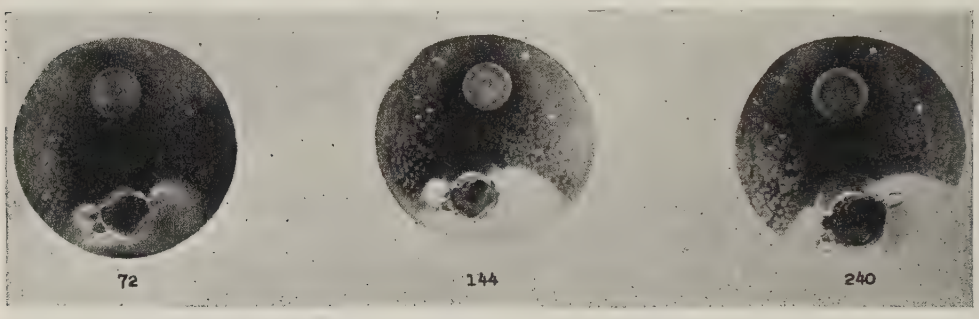

FIG. 1. Photographs of the development of the whitish area at the following intervals: left, 72 hours; center, 144 hours; and right, 240 hours. The copper penny is above and war-time penny below.

Within twenty-four hours after the war-time penny had been placed upon an agar plate a large whitish area formed immediately surrounding the coin (Fig. 1). At first this area was believed to be bacterial growth but because of its color and smooth peripheral edges, suspicion warranted a more detailed examination. One hundred Petri dishes were divided into five groups, twenty in each. They were handled in the following manner: the first group was set up with sterile Petri dishes, sterile pennies and sterile agar; the second group was made up with sterile dishes, sterile pennies and sterile agar, but these plates were streaked with a known bacterium; the third was prepared with sterile dishes, sterile agar and nonsterile pennies; the fourth group was composed of sterile agar, nonsterile dishes and nonsterile pennies and the fifth group, or control group, contained only sterile dishes and sterile agar. Both copper and war-time pennies were used in each of these plates.

[1]The author wishes to thank Fred. H. Norris, Department of Botany, for his aid with this experiment.

Between 18 and 24 hours after the material had been set up a whitish area appeared around the war-time pennies on all the plates but did not appear around any of the copper pennies. In the majority of plates it appeared before any signs of bacterial growth.

Material was taken from the whitish area of group one and was transferred to agar slants for culturing. No growth appeared on any of the twenty-four slants used. At the same time that the transfers were made, stained smears from the same area were prepared and studied. The smears were found to be free of organisms.

TABLE I

Width of Inhibiting Zone

	72 Hours	144 Hours	240 Hours
Copper Penny.....	12 mm.	19 mm.	21 mm.
War-time Penny.....	17 mm.	17 mm.	19 mm.

After 144 hours from the beginning of the experiment an inhibiting zone appeared around the whitish area of the war-time penny. This zone was not large but was clear of bacterial growth and remained so for ten days after the last recorded record. No bacterial colonies were observed on or in the whitish area, the effect seemed to extend in three dimensions.[2] The lack of growth on the slants made from the transfers, the absence of visible organisms in the smears and the production of an inhibiting zone around the whitish area seem to indicate that this whitish area around the war-time penny[3] is a diffusable precipitate or colloid rather than a bacterial growth. The copper penny produced an inhibiting zone that was in diameter 2 mm. larger than the war-time penny.

[2]Nadson, G. A., et C. A. Stern, De l'action a distance des metaux sur les bacteries et les levures. Compt. Rend. Acad. Sci. (Paris) 194 (18): 1597–1600. 1932.

[3]This coin contains steel compounds coated with an alloy of zinc.

NEW FULGOROIDEA FROM NORTH AMERICA (HOMOPTERA)

JOHN S. CALDWELL,
Circleville, Ohio

Oliarus acicus n. sp.

Length, male, 5 mm.; female, 5.8 mm. Black over all with pronotal and facial carinae dark brown. Elytra with veins and stigma black in male; veins brown in female with apex of claval suture blackened.

Vertex long, narrow, deeply notched caudad. Profile rounding. Face polished, tumid, oval in outline; median carina prominent on frons and clypeus. Mesonotal carinae prominent but concolorous with mesonotum. Elytra with veins scarcely punctate; claval veins united in basal fourth; five anteapical cells present. Post tibiae each with two preapical spurs.

Anal segment of male with long, acute, apical tooth projecting inward to genital cavity. Pygofers with either lateral magin produced caudad and basad in lateral aspect. Forceps not greatly enlarged apically; apices recurved, acute in lateral aspect. Aedeagus with two processes; the more apical process long, recurved.

Male holotype and paratype, Brownsville, Texas, 2–19–46, (Caldwell); female allotype and eleven paratypes, and one male paratype, Hermosillo, Sonora, 3–23–27, (MF 1220, Dampf); one female paratype and two male paratypes, Yaqui Valley, Sonora, 11–19–35, (MF 3980, Dampf); and a female paratype, El Dorado, Sinola, 1–22–30, (MF 1566, Dampf).

This species is common in insect collections from southwestern United States under the name *complectus* Ball from which it differs by having a longer tooth on the anal segment, a smaller periandrium without processes, and only two aedeagal processes.

Oliarus ecologus n. sp.

Length of male, 4.5 mm.; female, 5.5 mm. General color black. Carinae of face and median carina of mesonotum red; pronotal carinae light yellow. Elytra yellowish; veins and stigma yellow.

Vertex about twice as long as broad, trough-like, with median carina in basal half. Profile rounding. Median and lateral carinae of face elevated. Intermediate carinae of mesonotum curved, closer to outside than to median. Four anteapical cells present in either elytron.

Anal segment of male hood-like. Pygofer with either posterior margin evenly produced in lateral aspect; medioventral process short, triangular. Forceps broadened, evenly recurved apically. Genitalia illustrated in Ohio Biol. Sur. Bull. 35, vol. 6, no. 6, p. 301, figs. C, C 1, 1935. (Fig. C is mirror image of true position.)

Male holotype, female allotype, and many paratypes of both sexes from Pickaway Co., 7–1–36; paratypes same locality, 6–16–34, 7–8–36; Ross Co., 7–3–38; Jackson Co., 7–22–38; Licking Co., 6–16–34; and Lawrence Co., 6–24–34, all in Ohio. (Caldwell.)

Usually identified as *franciscanus* Stal but the distribution is entirely different since *ecologus* does not occur west of the Mississippi River. I have been unable to recognize *franciscanus* but it is probably one of the more common species occurring in California as an unrecognized synonym.

Oliarus zyxus n. sp.

Length of male, 5 mm. General color black with brown carinae; carinae of mesonotum reddish. Stigma and veins of elytra fuscous.

Vertex long, narrow, deep, trough-like. Face twice as broad at widest point as at apex; median carina prominent. Elytra little over twice as long as broad; punctations on veins scarcely visible; five anteapical cells present. Post tibiae with three anteapical spurs.

Anal segment of male short, hood-like. Lateral margins of pygofer greatly produced caudad; medioventral process narrow, rounded apically. Forceps long; flattened, recurved apically.

Periandrium produced into broad, flat, S-shaped structure on the left side; without a small median spur on inner margin; aedeagus with two apical and one subapical process in addition to three basal processes.

Male holotype and paratype, Nuevo Laredo, Nuevo Leon, 9–22–41, (DeLong, Good, Caldwell, and Plummer). Male paratype, El Torreon, Coahuila, (M B 237, Dampf). I have also seen examples of this species from Texas and Arizona in various collections.

Resembling *concinnulus* Fowl. and *littoralis* Ball, but differing from either by a slightly narrower vertex and in details of the male genitalia.

Cixius diastus n. sp.

Length of male, 6 mm.; female, 7 mm. Male flavous over all with black punctations on veins of elytra. Female generally flavous with lateral compartments of mesonotum slightly infuscate and with basal and apical areas as well as a median transverse stripe on elytra flavous. (Elytra is male sometimes faintly marked as in female.)

Vertex narrow, U-shaped; apical compartments transverse as in *basalis* V. D. Face narrow with median carina greatly elevated. Mesonotum longitudinally flat; median carina little evident posteriorly. Elytra almost three times as long as broad; veins densely punctate, punctations mostly paired. Post tibiae with two prominent anteapical spurs.

Anal segment of male enlarged basad. Pygofer evenly rounded on either side; medioventral process very broadly triangular. Forceps obliquely truncate apically. Aedeagus with three subapical processes.

Male holotype, female allotype, seven male, and thirteen female paratypes from Mexico, D. F., 9–1–39, West 18 Km., (DeLong & Plummer).

Resembling the male of *flavo-brunneus* Fowl. but according to Mr. W. E. China of the British Museum, ". . . is quite different in structure of pygofer, styles, and aedeagus."

Gaetulia obtusa n. sp.

Length of male, 7 mm.; female, 8 mm. General color green with two longitudinal dorsal stripes beginning light yellow on vertex and deepening to dark red on mesonotum. Veins on elytra black, marginal veins yellow, stigmal area clear.

Vertex much broader than long; apex obtuse. Frons narrow, little broadened apically. Facial carinae distinct. Male with latroposterior margins of pygofer truncate. Aedeagus with one lateral and one median process projecting from theca, these processes long and slender; a pair of small acute processes present at apex. Last ventral segment of female roundedly produced caudad with small rounded median notch in posterior margin.

Male holotype, female allotype, and a male and a female paratype from Tamazunchale, S. L. P., 11–15–38, (Caldwell). Two male and three female paratypes, same locality, 8–29–39, (DeLong). One male paratype, Valles, S. L. P., 12–1–38, (Caldwell).

Resembling *plennipennis* (Walk.) in size but lacking the colored stigmal areas on the elytra and with the shorter, broader vertex.

Gaetulia vulgaris n. sp.

Length of male, 6 mm.; female, 6.5 mm. Light green in color with a pair of longitudinal dorsal stripes of varying intensity. Cephalic carina of vertex and median carina of frons black. Veins yellowish, stigmal areas clear.

Vertex as long as broad, parallel sided. Frons little longer than broad, slightly narrowed basad. Latroposterior margins of male pygofer obtusely produced. Aedeagus with broad, blunt process projecting from left side of theca; a process present on left side half distance to apex; and a pair of short, broad processes present apically. Last ventral segment of female truncate apically with a small median notch in apical margin.

Male holotype, female allotype, twenty male and twenty female paratypes from Santa Engracia, Tamps., 11–9–39, (Caldwell). Very common on grass in an orange grove.

Resembling *nigrocarinata* Fowl. but smaller and without three black mesonotal carinae.

Pseudhelicoptera protubera n. sp.

Length of female, 5.5 mm. Face yellow except black apex; sides of head yellow with a broad, ragged edged, fuscous stripe present on either side from eye to apex. Vertex black; lateral margins yellow interrupted by three black dashes on either side. Pronotum fuscous, striped with white. Elytra ferruginous, spotted with small white callouses; veins more red than membranous areas.

Vertex long, narrow, trough-like; acute apically; lateral margins thin, much elevated. Frons narrowed basally, pinched laterally at base. Pronotum projected into vertex half length of eyes. Mesonotum tricarinate. Elytra lapped apically; veins regular, parallel. Hind tibiae with small basal spur. Last ventral segment of female with large, rounded, median notch on posterior margin.

Female holotype from Suchilapa, Oaxaca, 10–11–41, (DeLong, Good, Caldwell, & Plummer). (All types are in the writer's collection.)

Resembling *nasuta* Fowl. but with vertex less declivient and with narrower face.

OTODISTOMUM PLICATUM N. SP. (TREMATODA, DIGENEA) FROM HEXANCHUS GRISEUS (BONNATERRE)

MAIRE WEIR KAY,
Muellhaupt Scholar, Department of Zoology and Entomology,
The Ohio State University

An *Otodistomum*, differing in certain respects from the *Otodistomum veliporum* so frequently encountered in *Raja binoculata* at Friday Harbor, Washington, was obtained from the pyloric stomach of a specimen of *Hexanchus griseus* caught there during the summer of 1942. The worms, about one hundred in number, were at once noticeable because of their marked dorso-ventral compression, and because of their extreme variation in size. Living, extended specimens were observed from 10 to 105 mm. in length, with a maximum breadth of about 8 mm. Further study of fixed material has failed to identify these worms with *Otodistomum cestoides*, *O. veliporum*, or *O. pristophorus;* the species recognized in the genus. Accordingly, in spite of the somewhat tenuous distinctions which exist between the reported species it seems advisable tentatively to recognize the worm from *Hexanchus griseus* as distinct and hitherto undescribed. For this species I propose the name *Otodistomum plicatum.*

SPECIFIC DIAGNOSIS

Otodistomum plicatum n. sp.

This is an elongated, dorso-ventrally flattened worm which may exceed 100 mm. in length; with a maximum breadth of 8 mm. It is distinguished from other members of the genus by the possession of an exceptionally large cirrus pouch (1.43–2.36 x 0.84–1.57 mm.); an exceptionally small, compressed ovary (0.45–0.7 x 0.29–0.34 mm.); and an egg of unusual size (0.11 x 0.07 mm.) with a very thick shell (0.0075–0.008 mm.).

Locality: Friday Harbor, Washington.

Host: *Hexanchus griseus* (Bonnaterre).

Location in host: Pyloric stomach.

Type specimen: U. S. N. M. Helminthological Collection No. 36908.

DESCRIPTION

The living worm is elongated, ribbon-like, dorso-ventrally flattened; it is creamy white in color with the region just posterior to the ventral sucker darkened by the brown uterine eggs. Fifty-one fixed specimens varied in length from 8 to 83 mm. (average, 47 mm.) and in breadth from 3 to 7. 5 mm. (average, 5.2 mm.). Both large and small worms are, rather constantly, about 1 mm. thick; as much as 1.5 mm. at the level of the egg-filled uterus. The body is covered with folded, smooth cuticle which varies in thickness from 0.03 mm. on a 10 mm. worm to as much as 0.075 mm. on a specimen of 41 mm. As has been reported from other species, the cuticle is much thinned over the suckers; generally not exceeding 0.01 mm. in these areas.

The suckers are large and well-developed, with the oral sucker occasionally partially retracted into a fold of the anterior body. Numerous oblique bands, derived from the longitudinal muscle layer, and occupying the anterior dorsal portion of the body, control its extension and retraction. The ventral sucker extends nearly to the dorsal surface, but may be protruded considerably. The sucker diameter ratio is about 2 : 3; oral sucker from 0.9–1.5 mm., ventral sucker from 1.3–2.4 mm. in diameter.

The alimentary canal possesses no unusual features (Fig. 1). It consists of a buccal opening through the anterior sucker giving immediately on a large, muscular pharynx. This communicates with a pouch-like, thin-walled esophagus which branches laterally, and passes slightly anteriorad to either side of the pharyngeal bulb before giving way to the intestinal crura. The pharynx and esophagus are lines with a structureless membrane which is presumably continuous with the cuticle. The intestinal branches are large, more or less folded, and lined anteriorly with flattened or cuboidal epithelium from which protoplasmic processes extend into the lumen (Fig. 4). Posteriorly, particularly in immature worms, the epithelium is of a tall, columnar form, and two types of cells are present (Fig. 5); ill-defined cells bearing protoplasmic processes, and large, club-like cells filled with granules. The two crura extend almost to the posterior end of the body and may be somewhat unequal in length.

The excretory system resembles that of other members of the genus (Fig. 1). A posterior, terminal, excretory pore opens from a very large vesicle which occupies most of the posterior two-fifths of the body. Anteriorly this bladder is continued by two irregular canals which pass dorsal to the intestinal crura and continue along the lateral margin to the anterior tip of the body. The thin epithelial lining of this entire system is coated with masses of densely staining, globular bodies such as have been reported from a number of trematodes. Flame cells are abundant and widely distributed through the body.

The nervous system has not been studied in detail, but, as far as observed, it conforms to the general pattern of related species.

The organs of the male reproductive system are subject to considerable variation in size. Two testes lie one behind the other just anterior to the middle of the body (Fig. 1). The posterior testis is consistently slightly larger than the anterior (posterior, 23 mm. worm, 1.09 x 0.88 mm., anterior, 0.96 x 0.63 mm.; posterior, 58 mm. worm, 1.43 x 1.39, anterior, 1.35 x 1.31 mm.; posterior, average of ten specimens, 1.17 x 1.05, anterior, 1.08 x 0.99 mm.). From the anterior, median surface of each testicle a thin-walled, convoluted vas deferens, about 0.03 mm. in diameter, passes towards the anterior part of the body. These fuse beneath the anterior border of the ventral sucker, and immediately enter a large cirrus pouch to enlarge into a swollen, comma-shaped, seminal vesicle (Fig. 3). The seminal vesicle is lined by flattened epithelium and surrounded by sparse bundles on longitudinal muscle fibres which are continuous with the outer muscle layer of the ejaculatory duct. This duct arises from the anterior end of the seminal vesicle. It is lined with a low cuboidal epithelium and has both circular and longitudinal muscle layers. After coiling considerably, it emerges from the cirrus pouch near the anterior end, losing its epithelium which is replaced by thin cuticle. The ejaculatory duct terminates within the genital cone where it unites with the uterus before opening through the tip of the cone into the genital atrium. The cirrus pouch is a large, encapsulated, ovoidal structure lying dorsal and anterior to the anterior border of the ventral sucker in the left half of the body. In length it varies from 1.43 mm., in a 23 mm. worm, to 2.36 mm. in a 48 mm. worm; the average is about 1.97 mm. The peripheral portion of the pouch contains many cells similar to those which have been described as prostatic cells; the central portion is largely made up of loose fibres ramifying about the seminal vesicle and its associated ducts. The entire pouch is surrounded by a thin, irregular layer of muscle fibres.

The ovary is small and antero-posteriorly compressed. Size: 0.45 x 0.29 mm. in a 23 mm. worm; 0.7 x 0.34 in a 48 mm. worm; average, 0.61 x 0.30 mm. At most a few dozen developing ova are present at any one time, and a very few primitive oocytes. The organ is invested with a fibrous capsule which, on the anterior surface, is reflected inward to surround the funnel-like beginning of the oviduct (Fig. 7). A peculiar ring of ciliated cells lies on the ovarian side of this

membrane, immediately about the opening of the oviduct (Fig. 8). These possibly aid in directing the mature ovum into the duct.

Initially the oviduct is lined with a flat, pavement epithelium. The posterior portion takes a somewhat tortuous, anterior course and is joined, dorsally, by Laurer's canal and the common yolk duct (Fig. 2). It then enlarges slightly, and its lining changes to cuboidal, apparently ciliated, cells while it is surrounded by a thick layer of Mehlis' glands (Fig. 2, 7). At this point the duct may be considered an ootype. This ootypical portion is thrown into one or two transverse folds before losing its epithelial lining and becoming the membranous, egg-filled uterus.

Laurer's canal passes from its opening in the dorsal body wall to the oviduct along a variable course which typically passes just anterior to the ovary in the mass of loose connective tissue surrounding the ootype and terminates in the portion of the oviduct immediately posterior to the ootype. The common vitelline duct enters the oviduct at approximately the same point. This vitelline duct is the terminal portion of a dorsal yolk reservoir which is partially imbedded in the ootype capsule. The reservoir (Fig. 2) is an irregularly triangular body formed by the fusion of the lateral vitelline ducts which collect material from vitellaria distributed along the surface of the intestinal crura.

Anterior to the ootype the uterus is thrown into a series of transverse folds extending slightly beyond the posterior border of the ventral sucker. The anterior portion of the uterus (Fig. 1) passes dorsad to the right margin of the sucker to emerge ventrad to the median surface of the cirrus pouch in the mid-line of the body where it continues, with few convolutions, to enter the genital cone near its apex. The terminal portion of the uterus forms a strongly muscular metraterm, and well-developed circular and longitudinal muscle layers extend to the point where it fuses with the ejaculatory duct.

Eggs are very numerous and yellowish to dark brown in color. They are about 0.11 x 0.007 mm. in size and are surrounded by an exceptionally thick shell, 0.0075–0.008 mm. in thickness (Fig. 6). No attempt was made to study the intrauterine development of the egg, but the miracidia are apparently well-differentiated in the terminal part of the uterus.

The common portion of the genital apparatus consists of a cone (0.15 x 0.225 mm. in a moderately expanded specimen) in which the genital ducts unite, a genital atrium, and a genital pore. The atrium (Fig. 3) is an elongated chamber extending antero-ventrad from the genital cone to the genital pore. It may be subdivided into two parts: a posterior, enlarged chamber enclosing the genital cone, and an anterior tube terminating at the pore. The whole structure is lined with cuticle which becomes very thin near the tip of the cone. The musculature is complex; a circular layer extends the length of the atrium and is thickened into heavy rings in the wall of the posterior chamber; a number of longitudinal bundles are present, forming an incomplete layer; and fibres from the longitudinal muscles of the body wall extend obliquely to the wall of the anterior tube. These probably function together in the eversion and retraction of the cone. The total length of the atrium approximates a millimeter about equally divided between the two sections; the maximum diameter of the posterior portion is about 0.3 mm. while the anterior portion is half as broad. While the spatial relationships of the parts vary the structural details seem rather constant. Unfortunately no worms were available with the cone everted so that it was impossible to determine what changes in relationship this action would produce. The genital pore lies ventral to the esophagus and just posterior to the pharynx. About its margin the cuticle is thrown into folds which often take the form of small, inwardly directed papillae.

DISCUSSION

The characters by which species of *Otodistomum* are distinguished are far from satisfactory. Between the reported species there is very considerable overlapping

of characters. Yet Manter's careful and detailed study (1926) left him unwilling to disturb the existing taxonomy although, after critical comparison of *Otodistomum cestoides* and *O. veliporum* he ends by finding that, "The most certain distinction is egg size." *O. pristophorus* (Johnston, 1903) is distinguished by its peculiar, coelomic habitat; but, morphologically, Odhner (1911) considered it identical with *O. veliporum*. The confirmation of its coelomic occurrence (Woolcock, 1934) suggests that it is probably specifically distinct.

In comparing *Otodistomum plicatum* with *O. veliporum* collected in the same area, and with published descriptions of *O. veliporum* and *O. cestoides* the condition observed by Manter is evident; the worm is visibly different, but clear-cut, diagnostic characters are few. As he found, the egg size seems to be the most constant character, and this size is considerably above any previously reported in the genus. The ovary is regularly compressed and is smaller than that of comparable specimens of *O. veliporum* which I have examined or of *O. veliporum* and *O. cestoides* as given by Manter. However, the latter's work makes it doubtful that either size or position of gonads can be considered as distinguishing factors in this genus. The genital atrium appears distinctive, but the absence of specimens with everted cones makes it impossible to assess the diagnostic value of this character. The relatively immense cirrus pouch is the most clear-cut point of divergence between *Otodistomum plicatum* and its congeners. This difference appears early; an incompletely mature worm of 14 mm. had already a pouch length of 1.31 mm., *i.e.*, greater than that of the average adult of *O. cestoides* or *O. veliporum* (Manter, 1926). On the basis of these differences, then, if we recognize more than a single species in the genus, *Otodistomum plicatum* must be regarded as specifically distinct.

SUMMARY

A new species of *Otodistomum* is described from *Hexanchus griseus* (Bonnaterre). It is distinguished by unusual size of egg and cirrus pouch.

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EXPLANATION OF PLATE

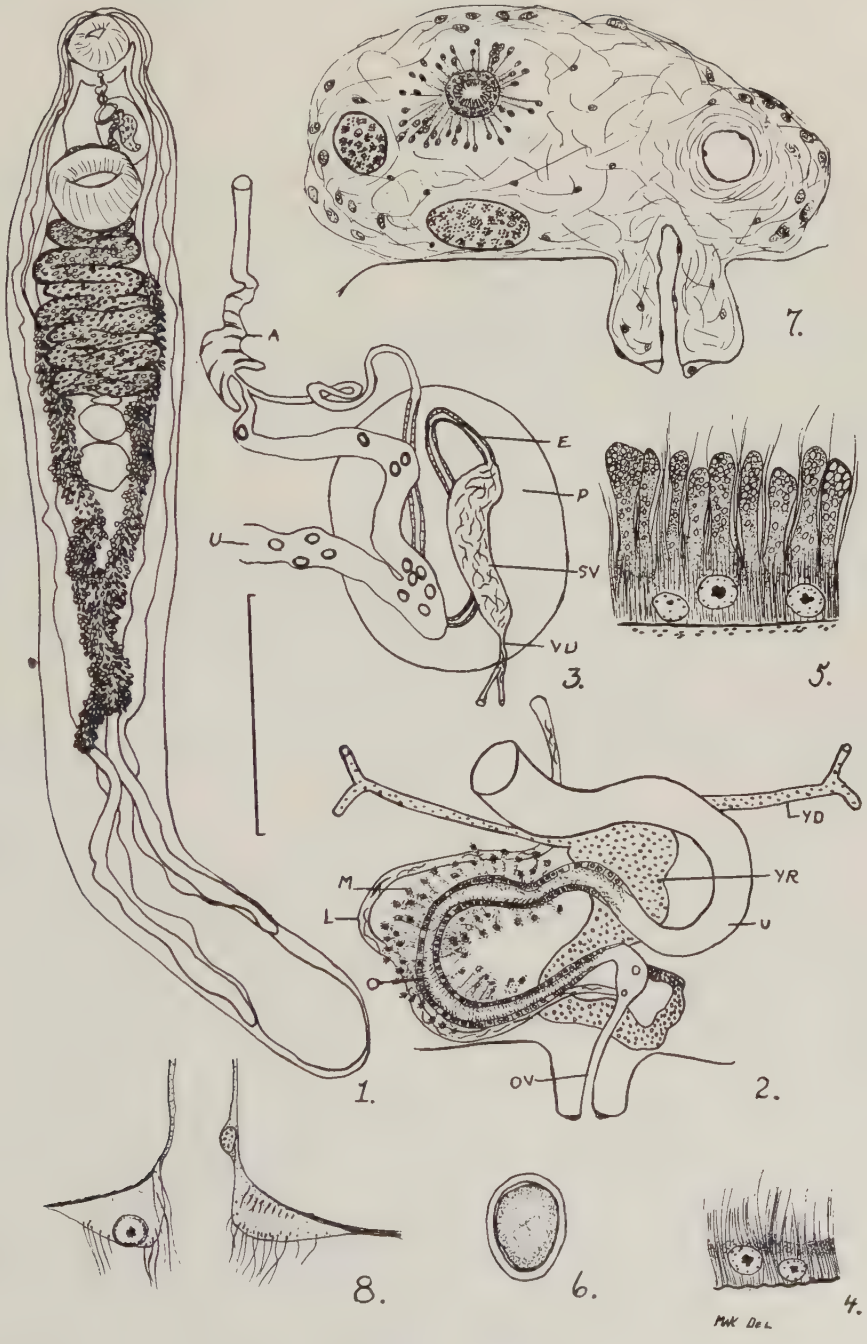
All stated magnifications are those at which the figures were drawn; reduction in reproduction is indicated by a five centimeter line accompanying the plate. The following abbreviations have been used:

A.....genital atrium.
E.....ejaculatory duct.
L.....Laurer's canal.
M.....Mehlis' gland.
O.....ootype.
OV.....oviduct.
P.....cirrus pouch.
SV.....seminal vesicle.
U.....uterus.
VD.....vas deferens.
YD.....vitelline duct.
YR.....yolk reservoir.

FIG. 1. Ventral view of entire worm. × 10.
FIG. 2. Reconstruction of the ootype and related structures. The parenchymatous capsule has been omitted. × 120.
FIG. 3. Reconstruction of the terminal genital ducts. × 40.
FIG. 4. Section through the anterior intestinal wall showing low cells and filamentous processes. × 1000.
FIG. 5. Section through the posterior intestine of an 11 mm. worm showing two cell types. × 1000.
FIG. 6. Uterine egg. × 200.
FIG. 7. Section through the ootype capsule. × 200.
FIG. 8. Section through beginning of oviduct showing ciliated ring. × 1000.

Otodistomum plicatum n. sp.
Maire Weir Kay

PLATE I



A SYSTEMATIC STUDY OF THE MAIN ARTERIES IN THE REGION OF THE HEART—AVES V—SPHENISCIFORMES

Part 2[1]

FRED H. GLENNY,[2]
University of Saskatchewan

The writer was fortunate in obtaining a single specimen of the Emperor Penguin, *Aptenodytes forsteri* (No. 106141), from the anatomical collections of the Chicago Natural History Museum, for this study.

In a previous paper (Glenny, 1944), the writer presented the arrangement-pattern of the main arteries of the neck and thorax of five species of Penguins. The arrangement of these same arteries in *Aptenodytes forsteri* is essentially the same as that of *Spheniscus demersus* (Glenny, 1944).

Minor differences may be noted, but these lie within the range of normal vascular variation, and are not to be regarded as being particularly significant as specific characteristics.

OBSERVATIONS

The subclavian artery and its branches are the same as in *Spheniscus demersus*. Both the right ligamentum botalli and the left ligamentum aortae are present in the adult.

Some differences are found in the arteries arising from the common carotid artery. The thyroid arteries arise from the short common carotid arteries posterior to the point of origin of the internal carotid (trunk) artery, superficial artery, and vertebral artery. These three arteries arise together from the common carotid artery. The subscapular artery arises from the superficial cervical artery, shortly after it branches from the common carotid.

The right superficial cervical artery comes to serve as the ascending-oesophageal artery. No major secondary branches were found arising from the superficial cervicals.

CONCLUSIONS

The thoraco-cervical arterial arrangement-pattern in *Aptenodytes forsteri* does not appear to deviate greatly from the general Sphenisciformes pattern.

In effect, the arrangement-pattern presented by *Aptenodytes* might be considered to be a basic ordinal arrangement-pattern, rather than a more highly specialized type which might be expected in a terminal species.

It is within the realm of possibility that *Aptenodytes* has retained the generalized arterial pattern which may have been present in an earlier, now extinct, ancestral form.

Close similarity in the arterial arrangement-patterns in six species of penguins, thus far studied, might lead one to conclude that this group of birds has almost completely run its course of divergences in the arterial pattern, and that, although there are relatively few extinct species, they show a high degree of similarity in structure and arrangement of arteries.

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[1]Contributions from the Blue Sea Lake Biological Laboratory, Messines, P. Q.

[2]Special Lecturer, Department of Biology, University of Saskatchewan, Saskatoon, Sask., Canada.

SOME ALGAE, INCLUDING NEW SPECIES, FROM NEW MEXICO[1]

CLARENCE E. TAFT,
The Ohio State University

The writer recently had the opportunity to examine several collections of algae from Valle Grande, in the vicinity of Los Alamos, New Mexico. The samples were collected by Dr. R. A. Popham, Department of Botany, The Ohio State University, during the spring of 1944 and the early summer of 1945 from an elevation approximating 9,000 feet.

The algal flora of New Mexico is generally unknown. As indicated by these samples, it would be well worth the time of some algologist to carefully survey this area by extending the time and scope of the collections. Although no fruiting Oedogoniaceae and only one member of the Zygnemataceae in fruit was discovered, members of both groups were numerous in vegetative condition. The paucity of fruiting material in either of these groups in alpine or subalpine habitats is notorious. Yet extensive collecting might result in some remarkable records. The large proportion of desmids in the collections is merely characteristic of alpine or subalpine regions and is probably indicative of a rich flora. No attempt has been made to identify the diatoms, which although numerous, do not predominate in the collections examined.

The writer is indebted to Dr. Popham for the samples and expresses his appreciation for the time and effort expended in their acquisition. He also wishes to thank Dr. G. W. Prescott of Michigan State College, Lansing, Michigan, for the use of his Iconograph of the Desmidiaceae as well as for his helpful comments and criticisms in species determination.

SPECIES LIST

CHLOROPHYTA

Volvocaceae
- *Pandorina morum* Bory.
- *Volvox aureus* Ehr.

Tetrasporaceae
- *Apiocystis brauniana* Nag.
- *Gloeocystis ampla* Kutz.
- *Sphaerocystis schroeteri* Chodat.
- *Tetraspora lubrica* (Roth) Ag.

Ulotrichaceae
- *Ulothrix zonata* (Weber & Mohr) Kütz.

Chaetophoraceae
- *Microthamnion strictissimum* Raben.

Zygnemataceae
- *Spirogyra tenuissima* (Hass.) Kuetz.

Desmidiaceae
- *Closterium kuetzingii* Bréb.
- *Closterium moniliferum* (Bory) Ehr.
- *Closterium pritchardianum* Archer.
- *Closterium striolatum* var. *subtruncatum* (W. & W.) Krieger.
- *Closterium tumidum* Johnson.
- *Micrasterias americana* (Ehr.) Ralfs.
- *Euastrum bidentatum* Näg.

[1]Paper from the Department of Botany, The Ohio State University, No. 492.

Euastrum denticulatum (Kirchn.) Gay.

Euastrum notatum Taft sp. nov. Fig. 2.

Cells small, longer than broad, constriction shallow and open; semicells quadrate-pyramidate, lateral margins concave; polar lobe nearly quadrate, apex slightly retuse and surrounded by four inconspicuous marginal lobes; basal angles broadly rounded; vertical view depressed hexagonal, all angles obtuse to broadly rounded and smooth, apical marginal lobes circularly arranged within the hexagon. Wall smooth and colorless. Length 37–43μ, width 27–29μ, isth. 17–19μ; width of polar lobe 16–17μ. Valle Grande, New Mexico.

This species should be compared with *Euastrum Berlini* Boldt (Boldt 1888) from which it differs in the broader isthmus, more broadly rounded basal angles, and the presence of the apical, marginal lobes.

Cosmarium botrytis var. *mediolaeve* W. West.

Cosmarium costatum Nordst.

Cosmarium cucurbitinum (Biss.) Lütkm.

Cosmarium ellipsoideum var. *minor* Racib.

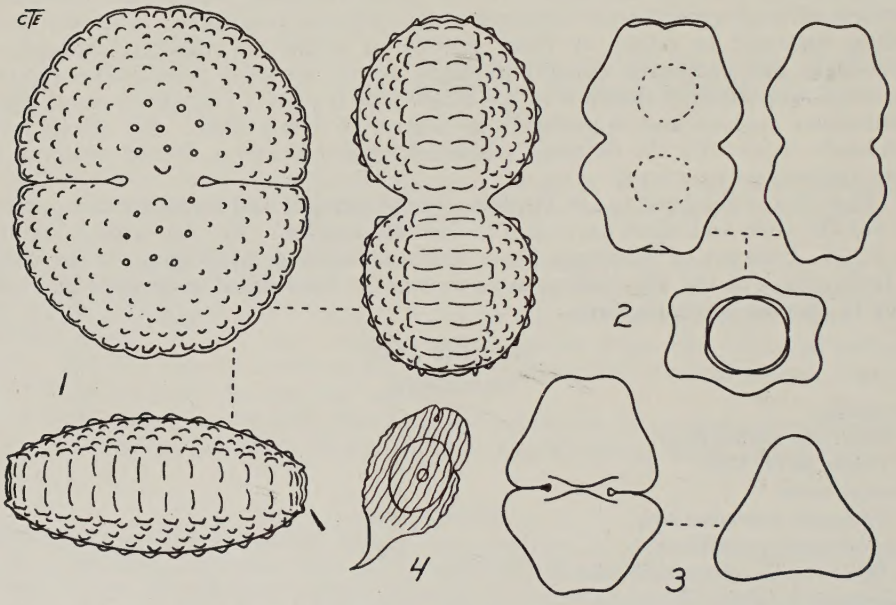

FIG. 1. *Cosmarium vallegrande* Taft, sp. nov.
FIG. 2. *Euastrum notatum* Taft, sp. nov.
FIG. 3. *Staurastrum trihedrale* var. *glabra* Taft.
FIG. 4. *Phacus crenulata* var. *annulata* Taft, var. nov.

Cosmarium holmiense Lund.

The dimensions of the only individual seen were greater than the usual size range. Length 64μ, width 38μ, isth. 19μ.

Cosmarium margaritatum var. *minor* (Boldt.) W. & G. S. West.

Cosmarium meneghinii fa. *reinschii* Istv.

Cosmarium speciosum var. *rostafinskii* fa. *americana* W. & G. S. West.

Cosmarium speciosum var. *simplex* Nordst.

Cosmarium subarctoum (Lager.) Racib.

Cosmarium subcrenatum Hantzsch.

Numerous zygospores were present. The dimensions were: 30–42μ diam. including processes, 27–32μ minus processes.

Cosmarium vallegrande Taft sp. nov. Fig. 1.

Cells about one-fifth longer than broad, deeply constricted, sinus linear, closed; semicells ovate-pyramidate, angles rounded, margins crenate; cell wall granulate, granules arranged in concentric series, smaller at the center and becoming larger near the margin, marginal series of broad, flattened verrucae; vertical view broadly elliptical with slightly flattened ends and having a row of verrucae on either side of the long axis, the intervening space crenulate.

Valle Grande, New Mexico.

Staurastrum polytrichum Perty.

Staurastrum punctulatum Bréb.

Staurastrum punctulatum var. *subproductum* W. & G. S. West.

This variety is identical in shape but slightly larger than *St. punctulatum* Bréb. forma? Boldt (Boldt, 1888). Length 46–48μ, width 40–42μ, isth. 16–17μ.

Staurastrum spongiosum Bréb.

Staurastrum trihedrale var. *glabra* Taft. Fig. 3.

Wolle described *St. trihedrale* as being punctate-granulate. The Oklahoma specimens (Taft, 1930) as well as those from New Mexico have a perfectly smooth wall. While Wolle's figure leaves much to be desired it is still the writer's opinion that these individuals should remain as a variety of his species.

Hydrodictyaceae

Pediastrum boryanum var. *longicorne* Racib.

Oocystaceae

Ankistrodesmus falcatus (Corda) Ralfs.

Nephrocytium limneticum G. M. Smith.

Oocystis lacustris Chodat.

Vaucheriaceae

Vaucheria pachyderma Walz.

Vaucheria sessils (Vauch.) D. C.

CHRYSOPHYTA

Xanthophyceae

Tribonema bombycinum (Ag.) Derbes & Sol.

Ophiocytaceae

Ophiocytium arbusculum (A. Br.) Raben.

Ophiocytium parvulum (Perty) A. Br.

EUGLENOPHYTA

Euglenaceae

Phacus crenulata var. *annulata* Taft var. nov. Fig. 4.

Cell ovoid-pyriform, posteriorly tapering into a sharp-pointed, slightly bent caudus, anterior end broadly rounded and bilobed; flagellum about as long as the cell; margins of the cell crenulate, with one sharp notch; periplast longitudinally striate, lines slightly undulate; paramylon body a single annular disc. Length 31–32μ, width 14–16μ.

Valle Grande, New Mexico.

The variety is distinguished from *P. crenulata* Prescott (1944) by having an annular disc paramylon body, a marginal notch, and a bent caudus.

Trachelomonas granulosa Playf.

Trachelomonas intermedia Dang.

Trachelomonas varians Defl.

Trachelomonas volvocina Ehr.

CYANOPHYTA

Chrococcaceae

Chroococcus turgidus Nag.

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BOOK NOTICE

Rheumatic Fever

In observance of National Heart Week, the Public Affairs Committee, Inc., has issued *Rheumatic Fever—Childhood's Greatest Enemy*, by Herbert Yahraes, the most comprehensive and readable pamphlet yet written on the disease that cripples and destroys more children of school age than any other disease, and that affects more than a million persons, young and old, in the United States.

"This booklet," according to Dr. David D. Rutstein, Medical Director of the American Heart Association, "represents a major step forward in bringing the essential facts concerning rheumatic fever before the American public. Rheumatic fever and rheumatic heart disease constitute one of our country's most pressing public health problems. Science is making progress in combating this disease which takes so many young lives and which attacked more than 40,000 members of the armed forces during World War II. It is the responsibility of every citizen to know the facts about rheumatic fever and to understand the tremendous need for community rheumatic fever programs in order to bring available knowledge within the reach of all sufferers from the disease."

The 32-page, illustrated Public Affairs Pamphlet contains all "the essential facts concerning rheumatic fever" and points to the need for community action on a broad scale. It was prepared by the Public Affairs Committee in cooperation with the American Council on Rheumatic Fever of the American Heart Association in order to provide needed public information on the disease as background for National Heart Week. The United States Junior Chamber of Commerce, the American Legion, Rotary International, Kiwanis International, and other organizations are cooperating in the national effort to stimulate public interest in the problems of heart disease, the greatest cause of death in the United States.

"Diagnosis of rheumatic fever is so difficult and treatment so complex and expensive," the pamphlet declares, "that medical men who have studied the disease most carefully say it can be fought successfully only by a public health program like the one that has been waged successfully against tuberculosis."

"Many different services are needed by the average rheumatic fever family," Mr. Yahraes points out, "and ideally they should be available in every community. They should be brought together by some central agency, perhaps the Department of Health, which would keep a register of cases as they were reported by private and school doctors and by welfare workers, and also a record of all the community facilities that might be of assistance."

"Within the last decade," according to the pamphlet, "considerable progress has been made in working out cooperation between the federal and state governments for financing public programs for the care of RF children. Federal money for that purpose was first set aside in 1939, when Congress authorized the Children's Bureau to include rheumatic children in the crippled children's program. This is financed by the national government under the special grant-in-aid provisions of the Social Security Act."

"The first joint federal-state program—Oklahoma's—was approved by the Children's Bureau in 1940. By 1947 there were twenty such programs, and a dozen others were being planned."

The London County Council's Rheumatism Scheme, which got under way in 1926, is described in the pamphlet as an example of a successful community plan. As a result of this cooperative effort in England by school and health authorities, by private and by public institutions, the incidence of acquired heart disease among London school children dropped from 2 per cent to 0.8 per cent in ten years, and there was a considerable decrease in the number of chronic cardiac invalids. In carrying out this scheme, London provided one hospital bed for every 550 school children. The ratio in New York City is only a fourth or fifth as high.

Rheumatic Fever—Childhood's Greatest Enemy, by Herbert Yahraes, is Pamphlet No. 126 in the series of popular, factual, ten-cent pamphlets issued by the Public Affairs Committee, Inc., non-profit educational organization, at 22 East 38th Street, New York 16, N. Y.